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MACHINERY

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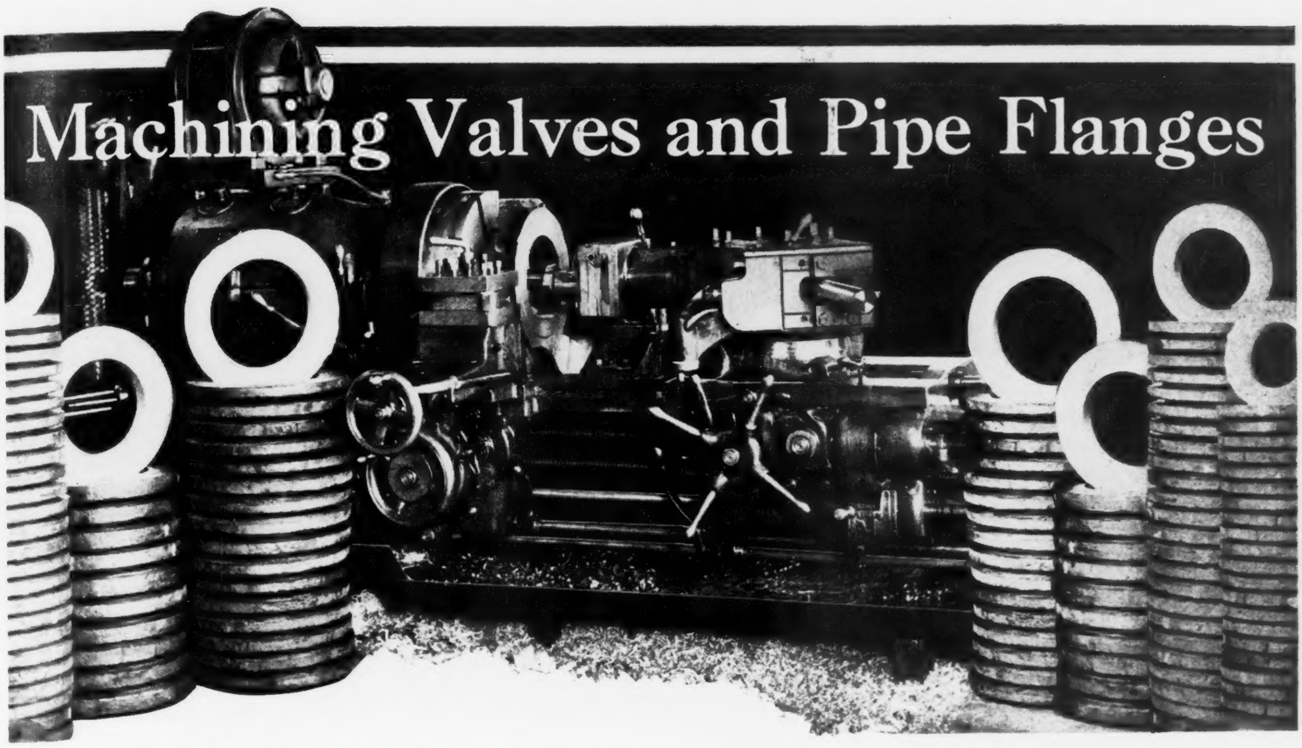
Machining Valves and Pipe Flanges



Use of Special Chucks and Tooling Equipment Designed With a View to Obtaining High Production

By CHARLES O. HERB

LARGE-SIZED angle- and globe-valve castings and pipe flanges can be machined at a high rate of production by using special chucks and tooling equipment designed for the purpose. The tooling equipment used for machining 8-inch angle-valves, as well as the equipment used for finishing pipe flanges, on Libby turret lathes built by the International Machine Tool Co., Indianapolis, Ind., is described in this article. The valves come to the machines in the form of rough castings, and are completely finished when removed from the machines, including facing, turning, boring, and threading operations.

One of the difficult problems incident to machining the valves was to design a chuck in which the work could be so indexed that all flanges of the valves could be machined in one set-up. The chuck finally made for holding the angle- or globe-valves is shown in Fig. 1. It consists essentially of a steel casting *A* which is threaded to fit the headstock spindle and has two arms in which is trunnioned casting *B*. The work is held in casting *B*, and this part is made in various sizes to accommodate different valves. It is readily interchangeable in casting *A*. Casting *B* is indexed on its trunnions to three positions for finishing the three flanges of globe- or angle-valves, the chuck being held in each position by means of a lock which is operated through handle *C*.

The work is clamped in place by straps *D*, being positioned by means of four set-screws in casting *B* and two

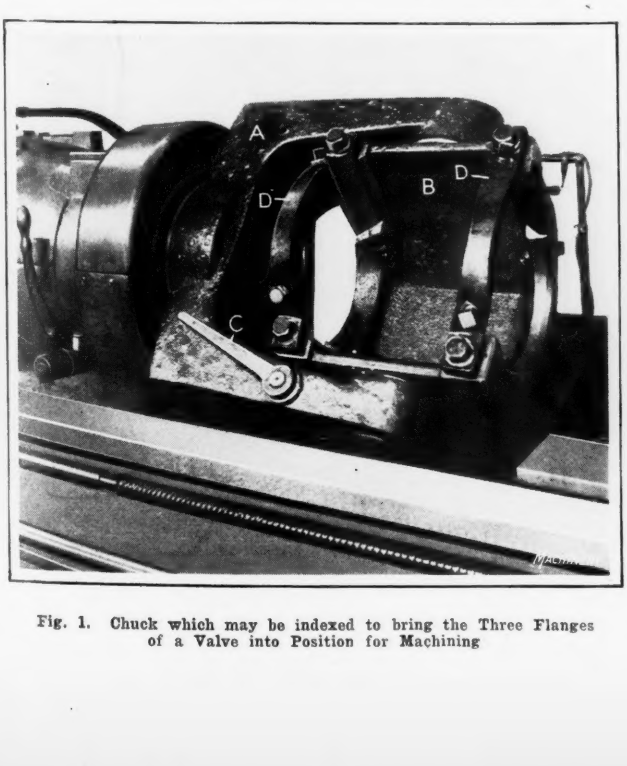


Fig. 1. Chuck which may be indexed to bring the Three Flanges of a Valve into Position for Machining

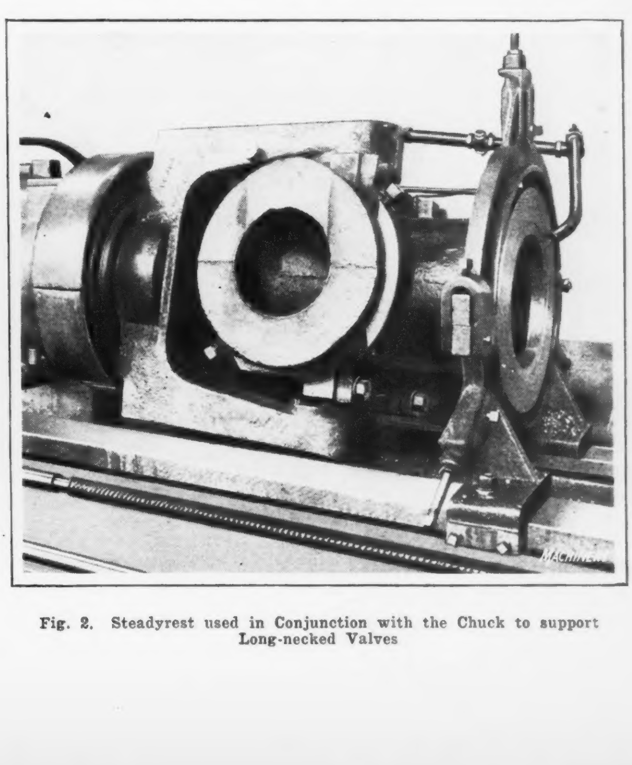


Fig. 2. Steadyrest used in Conjunction with the Chuck to support Long-necked Valves

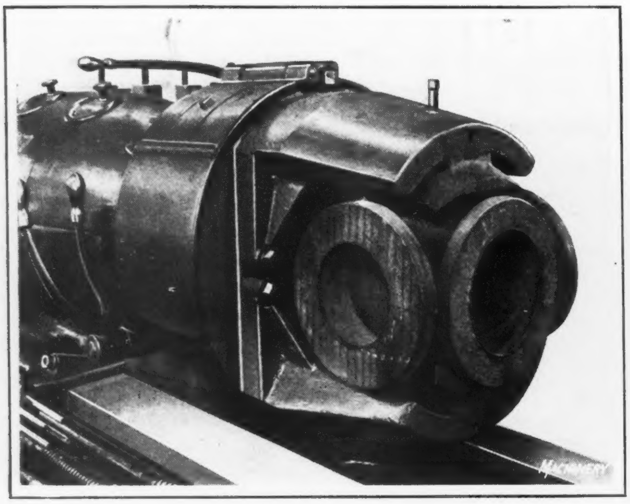


Fig. 3. Special Chuck used when the Valve need not be indexed

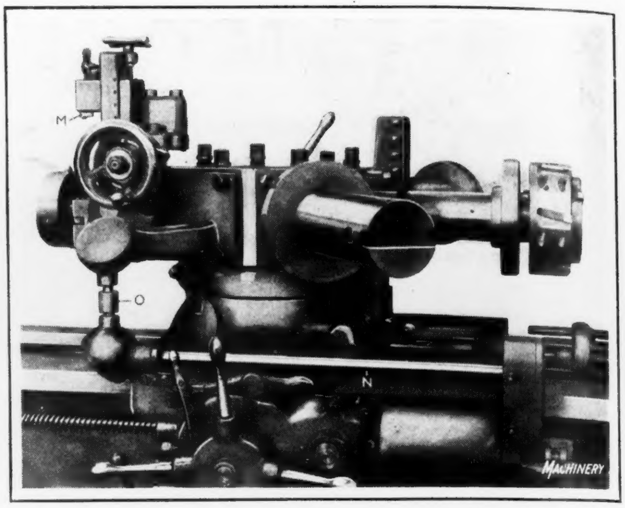


Fig. 4. Power-feed Mechanism for Cross-slide on Side 1 of Turret

set-screws on each strap. All these set-screws are arranged at an angle of 45 degrees, so that the valve is held as if in a V-block. The set-screws bear on two necks of the valve in back of the flanges. A lock-nut is provided on the set-screws to lock them in place after they have been adjusted to bring the center line of the valve approximately in line with the machine spindle. There are also other set-screws which bear against the back of two flanges to prevent endwise movement in the fixture.

In Fig. 2 the same chuck is shown loaded with a valve that has an extra long neck. In machining this valve, the flange at the end of the long neck is first turned, and then a steadyrest is applied, as shown, to support the overhanging end during the remaining operations. The additional support is desirable in view of the fact that this valve weighs about 540 pounds. It is a steel casting.

Chuck for Holding Valve when Indexing is not Required

Fig. 3 shows a chuck that was developed for holding a valve while turning, facing, and boring one flange; boring, facing, and threading for a seat ring; screwing in the seat ring, and facing and chamfering the ring. The other flanges are simply faced and turned, but these operations are performed on another machine. It will be seen that the valve is held on the turret lathe between two jaws mounted on arms that may be adjusted radially relative to the center of the spindle. There is a separate adjusting screw for each arm, so that first one may be positioned and then the other, after which they are both held in place by tightening nuts on T-bolts. The jaws are concave, so as to fit the curved part of the body. They are made of cast iron, but the arms of the chuck are steel castings.

Operations on the Valve

A drawing of the 8-inch valve, which is to be considered, is shown in Fig. 5, in which the heavy lines indicate the surfaces machined. The valve is set up in the chuck shown in Fig. 1, with flange *A*, Fig. 5, extending toward the machine turret. The first operation on the valve is to rough-turn surface *D*, rough-face surface *E*, and counterbore surface *F*. These cuts are all taken by means of tools mounted on the cross-slide attached to side 1 of the turret, as shown in Fig. 6. Tool *L* is fed by power along surface *E*, Fig. 5, to face the flange, and then an overhead cutter *M*, Fig. 6, is employed to turn the flange. This overhead cutter is also attached to the cross-slide, as will be seen from Fig. 4, which illustrates the power feed mechanism for the cross-slide.

Power for this purpose is delivered from the regular apron feed through spur gears to the horizontal shaft *N*, and then through bevel and spur gears and a connection *O* to the screw on the cross-slide. It will be seen that one pair of bevel gears is held on the turret and indexed with it, while the bottom pair remains in one position on the turret-slide. The vertical shafts of the two pairs may be disengaged by operating device *O*, to index the turret. The tooling equipment in Fig. 4 differs in several minor respects from that illustrated diagrammatically in Fig. 6.

The second step on the valve is performed with the tooling mounted on side 3 of the turret, and consists of rough-boring hole *G*, Fig. 5; surfaces *H* of three lugs to the same diameter as hole *G*; and hole *I*. There is a taper pilot bushing *P*, Fig. 6, on the boring-bar, which fits the rough bore *G* while lugs *H* are being machined, so as to steady the bar adequately during this intermittent cut. The cutters that bore hole *G* and surfaces *H* also face surface *J* as the step is completed.

The arrangement of the tooling used in this step is also shown in Fig. 9, from which it will be seen that two blades at the front of the special tool-head are used for boring surface *I*, Fig. 5. These blades have shanks which extend back into the boring head, and are each held in place by two set-screws which bear on the top of the shank. Six blades are placed around the head for boring hole *G* and lugs *H*, and facing surface *J*, each of these being also held in place by two set-screws which are tightened against one side of the shank. The pilot bushing is not shown in Fig. 9, and the long tool blades shown on the turret bracket were formerly used for finish-facing surface *E*, and finish-counterboring surface *F*.

The next step consists of threading hole *I*, Fig. 5, to receive the seat ring. This is accomplished by means of an eccentric tool held on

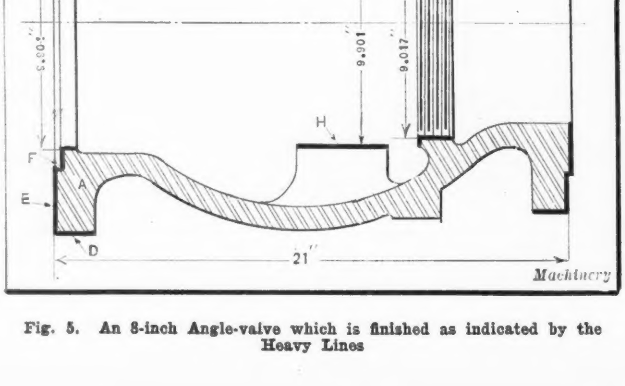


Fig. 5. An 8-inch Angle-valve which is finished as indicated by the Heavy Lines

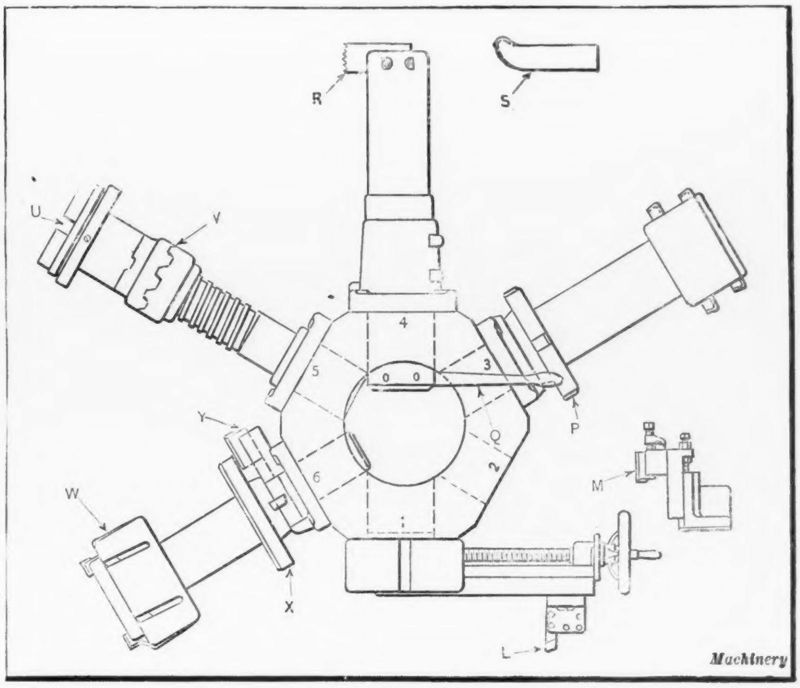


Fig. 6. Diagrammatic Illustration of the Tooling Equipment provided for finishing the Valve shown in Fig. 5

side 4 of the turret, which is shown in Fig. 7. Lever Q is lowered when the operation is finished, so that the tool R may be withdrawn from the work without distorting the threads. This tool also chamfers the corner formed by the junction of surfaces J and I, Fig. 5. After the thread has been cut, the chaser tool R is replaced by tool S, Fig. 6, which is used to finish-face seat J. This is accomplished by operating handle Q to feed the tool across surface J.

An unusual tool is employed in the next step to screw the seat ring into place. This tool is shown on side 5 of the turret in Fig. 6, and an enlarged view is shown in Fig. 8, where a seat ring is shown to the right of the tool. On the front end of the tool there is a cylindrical surface T on which the seat ring is placed, lugs on the ring engaging slots U in the tool. The teeth on clutch V are tapered in the direction of rotation at such an angle that the clutch will readily slip when the seat ring has been screwed into place. However, the coil spring will prevent the clutch from slipping before that time. As the clutch slips, the teeth produce a hammering action which positively seats the ring. The spring pressure may be varied by adjusting the position of the bushing which extends into the turret.

The last step performed on flange A, Fig. 5, of the valve is accomplished by means of the tool shown in side 6 of the turret, Fig. 6. There is a head W at the front end of this tool, and a pilot bushing X and boring head Y near the turret face. The cutters on the front side of head W bore the seat ring, while those on the larger periphery of the head finish-bore hole G and lugs H, Fig. 5. As the cutters start to finish lugs H, the narrow pilot bushing X, which is straight in this case, enters bore G so as to steady the bar. The cutters on head Y finish-counterbore and face at F. The face and periphery of flange A are only rough-machined.

Next the chuck is indexed to bring flange B in line with the turret, and then this flange is rough-faced, and rough-turned on the outside periphery and finish-turned at K, all these cuts being taken by tools mounted on side 1 of the turret. The chuck is then indexed a second time, and identical cuts are taken on flange C to complete the valve. With the 8-inch valve here considered, the production time for machining a valve complete is about 150 minutes, floor-to-floor time. A valve of the globe type is handled in about the same way as an angle-valve. The arm casting of the chuck shown in Figs. 1 and 2 is also used in machining valve bonnets, but a different trunnioned casting is required.

The heading illustration shows the tool equipment used on a Libby turret lathe for finishing 12-inch pipe flanges having an outside diameter of 19 inches and a threaded length of 2 1/16 inches. The operation consists of facing one side by means of tools on the toolpost of the side carriage, and of rough- and finish-boring, and threading the hole by employing tools mounted on the turret. The heading illustration shows the threading bar being withdrawn from the work. Owing to the fact that the side of the flange finished is that where the diameter of the hole is smallest, the operation is considerably complicated, because it means that the boring and threading tools must be fed radially as well as longitudinally in order to obtain the desired taper. However, the problem has been solved by means of a guide bolted to the back of the bed and special mechanisms mounted on the turret. Assembly views of the guide and one tool-head are shown in Fig. 10.

From the plan view shown at the right, it will be seen that there is a tubular body casting A bolted to the turret face, having a dovetail on the projecting end, into which is fitted an intermediate slide B. Dovetailed on the latter is a tool-slide C, and bolted to this is a holder D in which the tool is mounted. This construction is clearly shown in the heading illustration. During an operation, the tool-slide is fed with the intermediate slide, but after the operation has been completed, the tool-slide can be moved relative to the intermediate slide so as to permit the tool to be withdrawn quickly from the work. There is also an adjustment between the two slides for setting the tool to cut to the correct diameter.

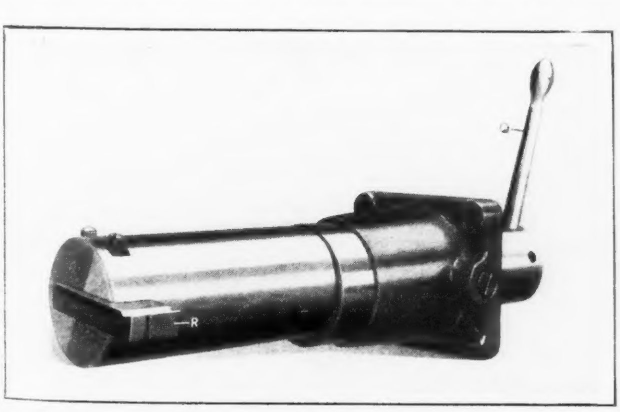


Fig. 7. **Eccentric Tool employed for chasing the Threads to receive the Seat Ring**

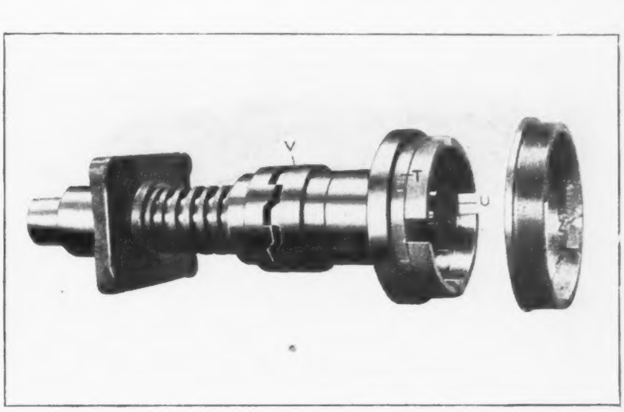


Fig. 8. Type of Tool employed for screwing the Seat Ring into Place in the Valve

The guide previously mentioned is bolted to the bed, as shown at *E*. On the top side of this guide there is a wide groove formed at an angle with the center line of the machine spindle by means of gibs. A roller *F* attached to the intermediate slide *B* enters this groove when the turret is advanced and thus, as the head is fed into the work, the groove forces roller *F* toward the front side of the machine, and being connected to the intermediate slide, the tool is also fed radially so as to cut to the required taper.

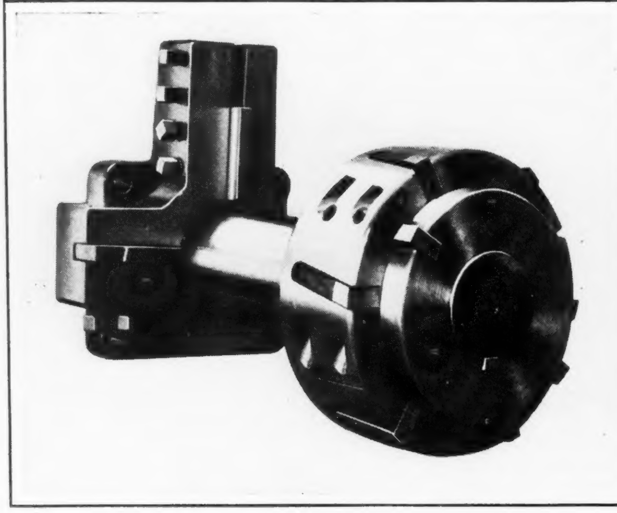


Fig. 9. Tool-head used in boring Hole G, Lugs H, and Hole I, and in facing Surface J, Fig. 5

After the hole has been bored in the pipe flange, lever *G* is pushed down against stop-pin *H*, which causes shaft *J* to make a partial revolution. This shaft has an eccentric lug at the front end, which engages a bushing *K* inserted in the rear side of the tool-slide. Thus, when lever *G* is manipulated, the eccentric lug pulls the tool-slide toward the rear of the machine sufficiently to withdraw the boring tool from the work so that the tool may be backed out. The relation between the intermediate and tool slides may be adjusted by screwing nut *L* in or out, which permits the tool to be set to the required diameter. The tool-head for the threading step is identical, except that a multiple tooth circular chasing tool is mounted in holder *D*, as shown at *X*. In both operations, the mechanism is supported by a pilot bar *M* which enters a bushing in the chuck, and while these operations are in process, facing cuts are taken by tools mounted in the side carriage. The floor-to-floor time required for machining this flange averages 12 minutes.

* * *

I have always thought that that old adage, with its humorous amendment, stated the two most important factors in accomplishment in a graphic way: "All things come to him who waits—and who hustles while he waits," the important factors expressed being patience and energy.—*G. W. Miller, President, Dodge Mfg. Corporation.*

AN OHIO VIEW OF BUSINESS CONDITIONS

The following opinions relating to business conditions are abstracted from a statement made by Frank B. McMillin of Mount Gilead, Ohio, president of the Ohio Chamber of Commerce and of the Manufacturers' Association of Central Ohio. The statements made by Mr. McMillin are based upon a careful and conservative analysis of reports from various sources and a close observation of general business conditions. Based upon these data, Mr. McMillin states that there is an almost universal expression of confidence in the present outlook. These expressions are the result of observation of actual facts; there is a general agreement that business is headed conservatively in the right direction. The facts indicating a certain, even if slow, business recovery are based upon statistical evidence—railroad car loadings, improvements in the building field, steel orders, a gradual improvement in the automobile industry, and increase in the price of farm products. The improvement in the European financial situation is another gratifying condition that will aid in the general business improvement. It is true that not all of the industries and business interests of the nation have as yet felt the new impulse toward improved business, but the total business of the country is rapidly approaching what should be called a normal condition. Mr. McMillin advises the members of the Ohio Chamber of Commerce to resist a boom and to prevent an inflation of prices.

* * *

A large Canadian hydro-electric power plant is being planned at the Grand Discharge of Lake St. John on the Saguenay River, thirty miles west of Chicoutimi, on which work has already proceeded for some time. A preliminary development of 225,000 horsepower is under way, but the plans make it possible to ultimately reach 390,000 horsepower.

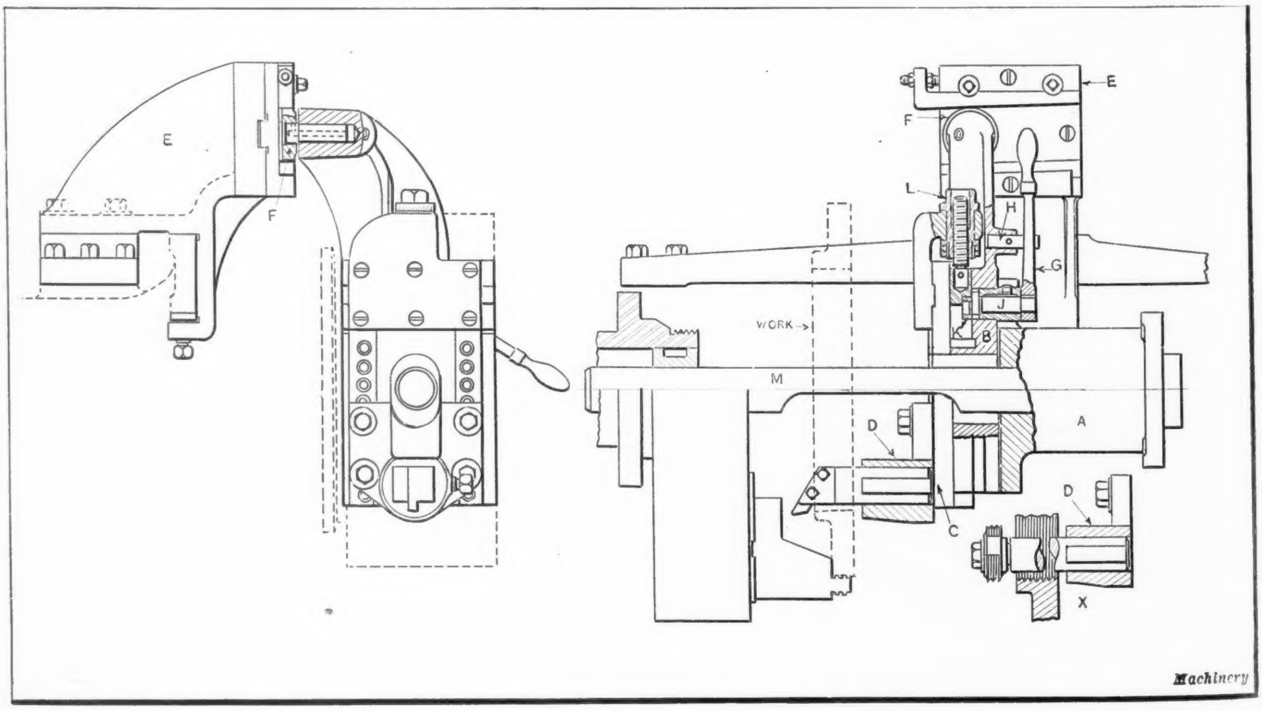


Fig. 10. Assembly Views of the Guide and Boring Head used for finishing Pipe Flanges

Planetary Gearing

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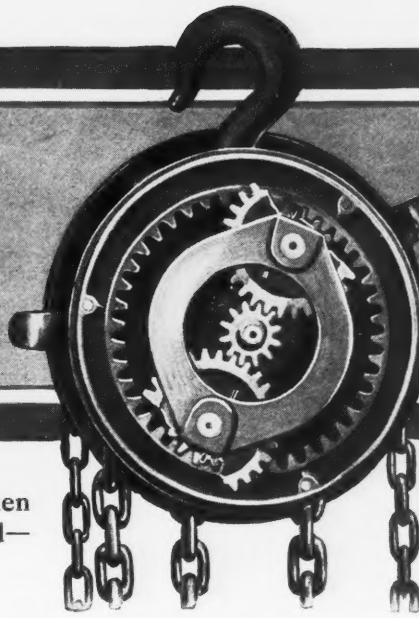
at Stevens Institute of Technology



Analysis of Planet Wheel Motion—Methods of Solution when Motion is Applied to Wheel which Ordinarily is Fixed—Fourth Article

THE third article of this series illustrated the solution of problems in Groups 2 and 3, by the methods shown to be particularly adaptable in the several cases, and then followed with several problems that were not assigned to any specific one of the three groups. The problems served to accentuate the necessity of discovering, at the outset, the group to which a new or original problem belongs. It will be recalled that Group 2 refers to problems in which the train arm is keyed to the driving shaft, and Group 3 to problems in which the train arm turns independently of the driving and follower shafts.

The present article begins with two problems that are quite different from any thus far considered in that they consist of only one fixed sun wheel, a train arm, and one planet wheel follower, and call for an analysis of the motion of the planet wheel follower only. These two problems are well known, and are frequently discussed when the subject of planetary gearing is casually broached, with the result that there is no final agreement in many instances. The question generally at issue is, "How many times does the planet wheel turn as it rolls, or swings, once around the fixed sun wheel?" These two problems are not merely academic. They have important practical applications, as, for example, in rope manufacturing machinery. The following notation is used:

N = number of turns of driver to one of follower or driven member;

N' = number of turns of follower to one of driver;

N_1 = number of turns of driver to one complete revolution of planet wheel axis;

N_2 = number of turns of follower to one complete revolution of planet wheel axis;

D = diameter of pitch circle of driver, if driver is a toothed wheel; (The driver, or the follower, may be the "train arm" and not one of the toothed wheels, according to the data of a problem.)

D_1 = diameter of pitch circle of follower, if follower is a toothed wheel;

D_2 = diameter of pitch circle of fixed wheel; and

D_3, D_4, etc., = diameters of pitch circles of planetary wheels.

Analysis of Planet Wheel Motion—Problem 12

Problem 12—Given: A fixed sun wheel $D_2 = 24$, and a planet wheel D_3 of the same size, held in place by a train arm and rolling in gear with the sun wheel (Fig. 14). How many times will the planet wheel turn on its own axis, and how many times will it turn on the train arm pin while it rolls once around the fixed sun wheel D_2?

The solution of Problem 12 is of special interest and value, as it affords an acute test of the understanding of the action of the planet wheel itself, although the complete analysis of its action is not necessary in the solution of the ordinary planetary gear mechanism. The problem is also of value in bringing out the fact that a short line drawn at any distance out on a crank-arm may be considered as rotating once about its central point while the crank-arm makes one turn with the shaft. This principle has been taken advantage of in certain types of mechanism. The problem is of further interest in that it illustrates the value of precision in expression in stating a problem, as will be observed if the following "popular" statement of the problem is considered, "How many times does one wheel turn while it rolls around another wheel of the same size?" The question in this form, due to its ambiguity, has provoked a wide discussion.

Problem 12 is a special case of planetary gearing, and, for simplicity, a special method of solution will be used first, after which the three regular methods of solution will be applied. The special method of solution consists simply in applying the definition of the term "angular velocity," which is "the linear velocity divided by the radius." In this problem, then, the angular velocity of the train arm AM, which carries the planet wheel D_3, is $\frac{AB}{AM}$, where AB is taken to represent the tangential linear velocity of the point A of the train arm. From the construction of the mechanism, the point A of the planet wheel D_3 must have the same tangential linear velocity AB as the point A of the train arm. But the planet wheel D_3 is rotating about the instantaneous axis C because it is in mesh with the fixed sun wheel D_2. Therefore, the angular velocity of the planet wheel about C is $\frac{AB}{AC}$, which is a measure of the rate of rotation of the planet wheel about its own theoretical center point A, for, if this center point of the planet wheel has a velocity AB, and the rim at P has a resultant velocity PE the net rotating velocity about A is $PE - AB = PF$, and the angular velocity of the planet wheel about its own center is $\frac{PF}{PA} = \frac{AB}{AC}$.

If, then, the angular velocity of the train arm is $\frac{AB}{AM}$ and the angular velocity of the planet wheel about its center A is equal to $\frac{AB}{AC}$, the angular velocity of the wheel in terms of the angular velocity of the train arm is $N' = \frac{AB}{AC} \div \frac{AB}{AM} = \frac{AM}{AC} = \frac{24}{12} = 2$, or in other words, the planet wheel D_3

rotates twice on its own theoretical center A while it rolls once around the fixed wheel D_2. It may be of interest to note that the point P of the planet wheel describes the path of the epicycloid $P\ P_1\ P_2$ as the wheel D_3 rolls on the fixed wheel D_2.

Applying the regular methods of solution to Problem 12, we have, by the graphical method $N' = \frac{PE}{AB} = 2$. The value PE is taken in this case because, in using linear velocities, it will be remembered that for a comparison of angular velocities, the linear velocities must both be taken at the same radial distance. Since AB is the linear velocity of the train arm at the radial distance AM, and since AB is the linear velocity of the planet wheel center at the radial distance AC, it must be increased to its corresponding value at the radial distance CP which is equal to AM. This increased value is PE, and therefore AB and PE are the true comparative graphical measures of the rates of rotation of the train arm and the planet wheel, respectively, about their own centers.

In the geometrical method, there are but two similar triangles ACB and PCE and $\frac{PE}{AB} = \frac{PC}{AC} = \frac{24}{12} = 2$.

According to the analytical method,

$$N' = 1 + \frac{D_2}{D_3} = 1 + \frac{24}{24} = 2$$

Rotation of Planet Wheel Relative to its Pin

It has been shown in the preceding paragraphs that the planet wheel D_3 rotates twice on its own center while it rolls once around the fixed wheel D_2. The next question that arises is, "Does it also turn twice on the pin G?" To answer this, it should be determined whether or not the pin G rotates on its axis AA' while the crank-arm to which it is keyed is rotating on its axis M. Suppose that a vertical arrow, pointing upward, is drawn on the end of the planet wheel pin G as shown; then when the train arm or crank MA has made a half turn, the arrow is again vertical, but is pointing downward as shown at A_2; and it has also made a half turn about its central point or axis A. It will thus be seen that the planet wheel pin G is rotating about its own axis A at the same rate that the crank is rotating about its axis, and both are rotating in the same direction.

If, as already shown, the planet wheel D_3 is rotating twice on its center A while the crank is rotating once, and if the planet wheel pin is rotating once on the same center A in the same time and in the same direction, it follows that the planet wheel will turn once on the pin G while the crank or train arm rotates once about its center at M. This has a practical application, as illustrated at the left in Fig. 14, where the planet wheel D_3 and the pin G have combined relative rotation and horizontal translation, the same as in a nut and bolt. With this construction it may be noted that the planet wheel will turn once on the pin G and that it will advance one full thread to the left, while the crank or the train arm MA rotates once about M.

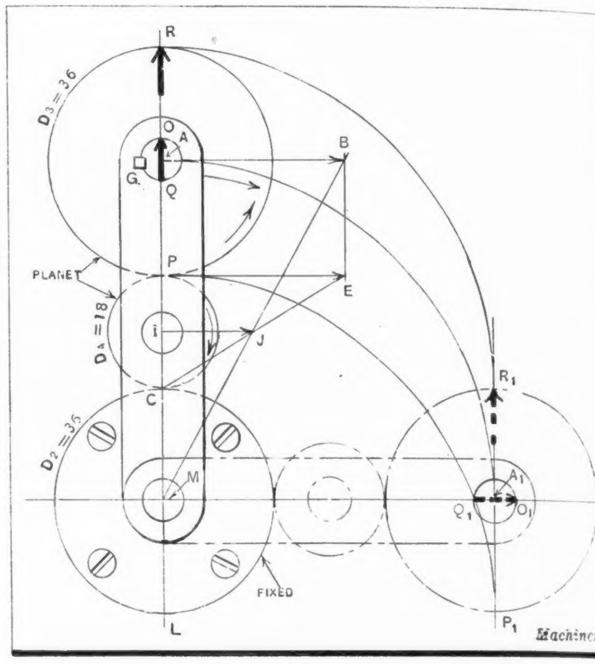


Fig. 15. Action of Planet Wheel when it has Motion of Circular Translation—Problem 13

Planet Wheel Motion when Intermediate Planet Wheel is Used Problem 13

Problem 13—Given: A fixed sun wheel $D_2 = 36$, and a train arm carrying two planet wheels, one $D_4 = 18$ and the other $D_3 = 36$, as shown in Fig. 15. How many rotations does the planet wheel D_3 make on its axis, and how many turns on the planet wheel pin G while the train arm AM rotates once about M?

Problem 13 illustrates a detail of a common device used in making wire rope, the wheel D_3 representing a spool carrying individual wires or strands and feeding them with little or no twist, as desired, as they are laid in the finished rope. The complete mechanism will be described later. This problem is also a special case of planetary gearing, and a special method of solution, depending fundamentally on the definition of angular velocity, affords, perhaps, the most satisfactory way of explaining it as follows:

The angular velocity of the driving train arm AM is $\frac{AB}{AM}$. The angular velocity of the planet wheel D_3 about its center A is $\frac{-PE + AB}{AP}$. The minus sign is placed before the quantity PE because the motion represented by PE tends to turn the planet wheel D_3 in a counterclockwise direction about the center A, and counterclockwise motion, or motion opposite to that of the driving motion, when represented in these for-

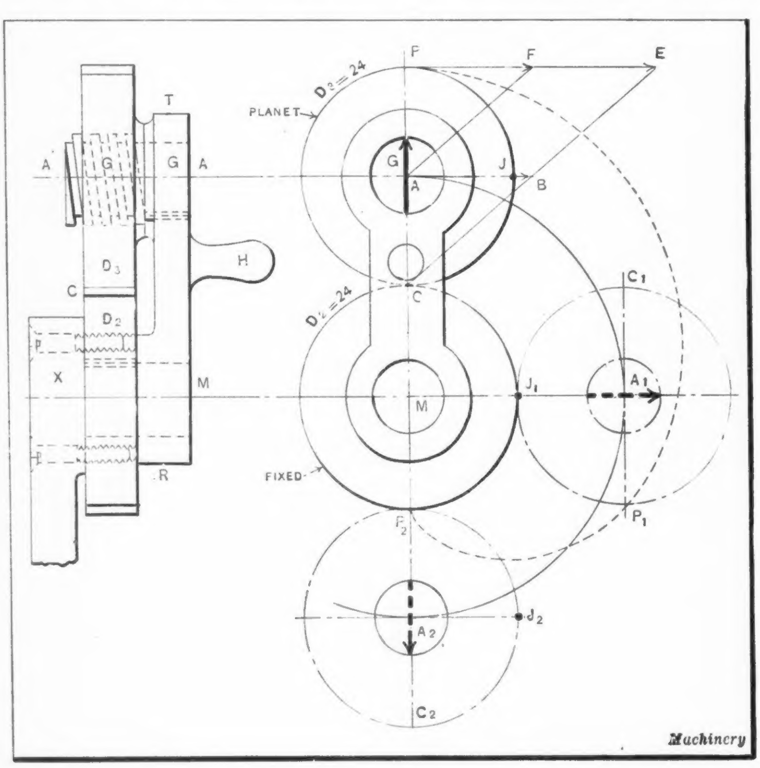


Fig. 14. Diagram illustrating Analysis of Planet Wheel Motion—Problem 12

mulas is always preceded by the minus sign. The motion of the center A of the wheel, represented by AB is in a clockwise direction and is plus. Assuming linear velocity values for AB and PE, both to the same scale, and then dividing the angular velocity of the driver by that of the follower, we have

$$N = \frac{AB}{AM} \times \frac{AP}{-PE + AB} = \frac{10 \times 18}{54 \times (-10 + 10)}$$

$$= \frac{10}{3 \times 0} = \text{infinity}$$

or, in other words, it would take an infinite number of rotations of the train arm AM about M to produce one rotation of the planet wheel D_3 on its own axis. This, of course, is equivalent to saying that the planet wheel D_3 does not rotate at all about its axis.

This is illustrated in Fig. 15 where a vertical arrow is drawn on the face of wheel D_3 at R. When the train arm is rotated 90 degrees so that the center A of the planet wheel is at A_1, the arrow, now shown at R_1, is still in a vertical position, as it was at the start. When a body moves in a path in such a way that a given line on the body remains parallel to itself in all positions, the body is said to have a motion of translation. In this illustration, the center A of the planet wheel D_3 moves in the circular path AA_1, and all other points in the wheel move in equal circular paths, as shown at RR_1 and PP_1, so in this case the wheel D_3 has a motion of circular translation.

The number of turns of the planet wheel D_3 on the pin G in a given time, may be determined most readily by an inspection of the diagram. The mechanical construction of the device is to be kept in mind, it being noted that the planet wheel pin G is keyed in the train arm AM and that the planet wheel D_3 turns freely on the pin. If, then, a vertical arrow is drawn on the pin, as at A in the initial position, it will be in the horizontal position as at A_1, when the train arm is rotated 90 degrees. The vertical arrow at R in the initial position of D_3 will still be vertical after the center of the wheel has been carried through one quarter of a revolution by the train arm.

From this it will be seen that the wheel D_3 makes a quarter turn on the pin G while the pin is revolved 90 degrees, and that it will make one full turn on the train arm pin while the train arm rotates once. The direction of turning, however, will be counterclockwise, or opposite to the direction of rotation of the train arm. In Problem 12 the planet wheel also turned once on the planet wheel pin while the train arm made one rotation, but in that problem the direction of turning was clockwise, or in the same direction as the train arm. This matter of direction is of importance in any mechanical adaptation, particularly if the planet wheel hub and pin are threaded, as in a nut and bolt, as illustrated in Fig. 14.

Graphical and Analytical Methods Applied to Problem 13

The regular graphical method of solving Problem 13 may be applied by substituting values of AB, AM, AP, and PE as taken directly from the diagram, and using them in the formula developed in the first paragraph devoted to this problem. The value of PE, in general, will come out as an inexact quantity due to draftsmanship and the result will only be approximate. The regular geometrical method may be used to insure precision by computing the value of PE from the known sides of the triangles MAB, MIJ and CPE. The analytical method applies particularly well and offers the quickest solution as follows:

$$N' = 1 - \frac{D_3}{D_4} \times \frac{D_4}{D_3} = 1 - \frac{36}{18} \times \frac{18}{36} = 1 - 1 = 0$$

$$N = \frac{1}{N'} = \frac{1}{0} = \text{infinity}$$

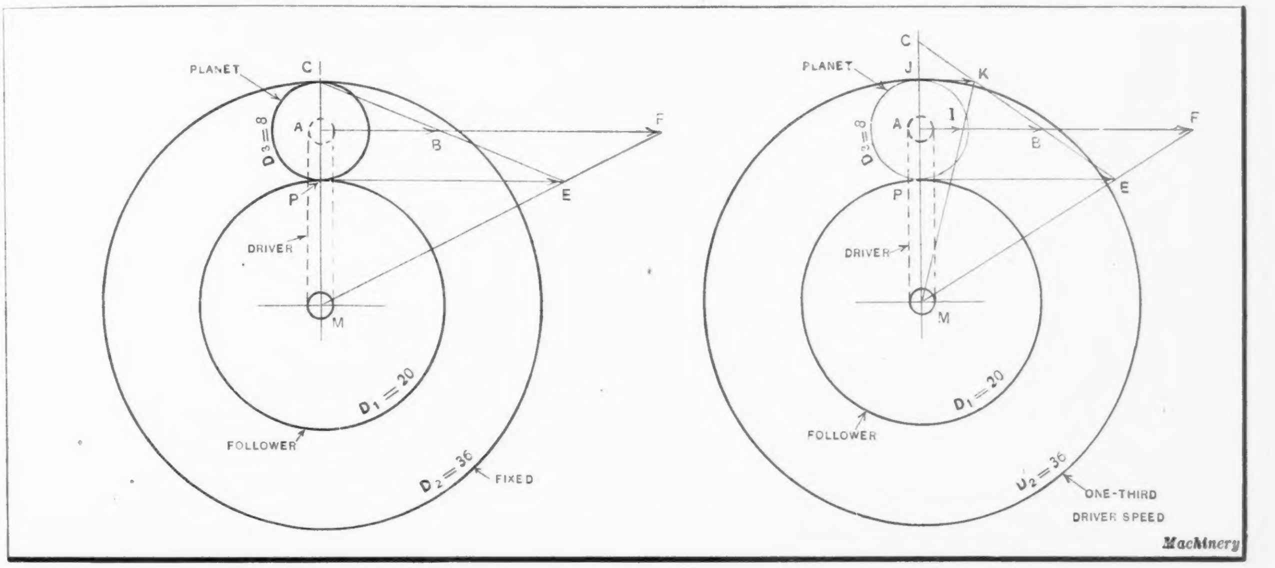


Fig. 16. Ordinary Planetary Gear Problem used for Comparison with Special Case represented by Fig. 17

Fig. 17. Problem in which a Wheel ordinarily fixed is rotated at One-third Speed of Driver—Problem 14

In other words, as already established, the planet wheel does not rotate at all on its own axis.

Motion Given to Wheel which Ordinarily is Fixed

Planetary gear mechanisms of the usual order do not readily lend themselves to universal adoption; that is, a specially desired result cannot always be obtained because of the fact that the numbers of teeth that may be cut on the wheels must be whole numbers, and these numbers, or numbers proportional to them, become the actual factors that are used in the formulas in solving the problems. The numbers of teeth being limited to whole numbers, no fractional values can be used for the several values in the formula, and consequently the resulting reduction in velocity ratio is limited to a progressive series of steps, and intermediate values between these steps cannot be obtained. This occurs in all cases where the "fixed" wheel remains fixed all the time. It is obvious, however, that the so-called "fixed" wheel, which acts as a fulcrum for one of the planet wheels, may also have any assignable motion, and if this is properly controlled, it is apparent that planetary gear mechanism can be made to approach much nearer to a universal application. The assignment of a motion to the so-called "fixed" wheel in planetary gearing is comparable to the use of a vernier in obtaining extremely small divisions of a unit of measurement.

To illustrate the case where the so-called "fixed" wheel has a definitely assigned motion, the mechanism represented in Figs. 16 and 17, and solved in the following paragraphs, will be used. Anti ipating the result, it may be determined from the graphical constructions in these two figures that the driver makes 5/14 of a turn to one of the follower in Fig. 16 where the "fixed" wheel remains fixed, and that it makes 5/11 of a turn to one of the follower in Fig. 17 where the "fixed" wheel turns at one-third the rate of the driving wheel.

Problem 14—Given: A planetary gear mechanism in which the so-called "fixed" wheel $D'_2 = 36$ (internal) turns at one-third the speed of the train arm, which is the driver. The follower wheel is $D_1 = 20$, and the planet wheel is $D_3 = 8$ (Fig. 17).

For later comparison, Problem 14 will first be solved as if the "fixed" wheel remained fixed. Solving by the graphical method, $N = \dfrac{AB}{AF} = 5/14$ approximately, Fig. 16. This is a problem in which the answer, obtained by the analytical method, would be naturally in terms of revolutions of follower per one of driver, because the driver is the train arm which carries the planet wheel pin. Therefore $N = \dfrac{1}{N'}$.

Then

$$N' = 1 + \frac{36}{8} \times \frac{8}{20} = \frac{14}{5} \quad \text{or} \quad N = 5/14$$

In solving Problem 14 by the graphical method, let AB, Fig. 17, represent the linear velocity of the point A on the driving train arm MA. Then if the so-called "fixed" wheel D'_2 has one-third the angular velocity of the train arm, it will have a linear velocity of AI which is one-third of AB at the radial distance MA; and at the radial distance MJ the tangential linear velocity will be JK. The velocity of the point J of the planet wheel D_3 will also be JK. Therefore the two points A and J of the planet wheel are moving with the parallel but unequal velocities AB and JK respectively, and the instantaneous axis for the planet wheel is at C.

Any other point such as P on the planet wheel D_3 is also moving about C with the same angular velocity as the points A and J, and therefore the linear velocity of the point P on the planet wheel, and of P on the follower wheel D_1 is PE. If PE is the linear velocity of a point on the follower at a radius MP, the velocity at the radius MA will be AF. Since AB represents the velocity of the driver, and AF the velocity of the follower at the same radial distances, the answer by the graphical method will be $N = \dfrac{AB}{AF} = 5/11$.

Solving Problem 14 by the analytical method, the same procedure is followed as in past problems in which (1) all parts were revolved as one solid piece about the sun wheel center M; (2) the "fixed" wheel was revolved back (counter-clockwise) through a full turn. In addition, in this problem, the fixed wheel will have to be (3) revolved clockwise one-third of a turn to meet the requirements of the data. This would give the formula

$$N' = 1 + \frac{D'_2}{D_3} \times \frac{D_3}{D_1} - \frac{1}{3} \times \frac{D'_2}{D_3} \times \frac{D_3}{D_1}$$

In a practical application, this formula would, of course, be shortened to

$$N' = 1 + \frac{2}{3} \times \frac{D'_2}{D_3} \times \frac{D_3}{D_1}$$

which is the same as saying, in the analysis, that the so-called "fixed" wheel need only be turned back two-thirds of a turn in order to have it in the position it will actually occupy when the train arm has revolved through 360 degrees. Substituting the values given in the data for Problem 14 in the formula just given

$$N' = 1 + \frac{2}{3} \times \frac{36}{8} \times \frac{8}{20} = \frac{11}{5} \text{ and } N = \frac{1}{N'} = \frac{5}{11}$$

BORING AND FACING CAST-IRON GEAR BLANKS

By W. PARKER

One of the most unusual as well as profitable jobs ever carried out under the writer's supervision was that of boring and facing 400 cast-iron helical gears, one of which is shown in the view at the right-hand side of Fig. 1. As the shop in which these blanks were machined was not provided with a turret lathe large enough to handle the job, a Reed

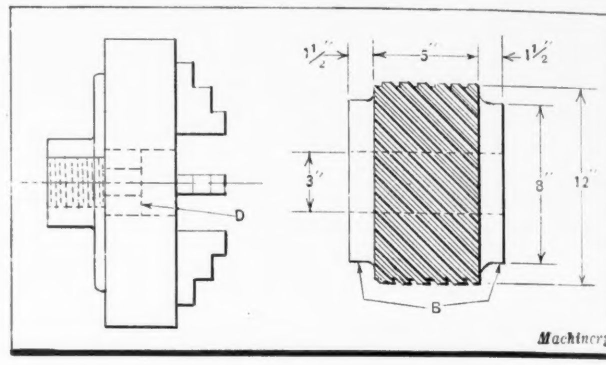


Fig. 1. (Right) Cast-iron Gear Blank; (Left) Chuck used for holding Gear Blank and supporting Boring-bar

lathe was equipped for the work. The 3-inch hole in the blanks was cored out with an allowance of about ½ inch for finish-boring. The gear blanks were extremely difficult to hold and true up in a four-jaw chuck, owing to the eccentricity and roughness of the hubs at points B.

The boring-bar shown in Fig. 2 was made and attached to the lathe tailstock spindle by means of a sleeve A. A special key E was set into the tailstock spindle to resist the torsional strain of the cut. The pilot C was supported by the bushing D, Fig. 1, the hole being finished to size after the bushing was pressed into the chuck body and the chuck screwed on the spindle. The object in mounting the pilot bushing in the chuck was to obtain a support for the boring-bar at a point as near the cutter as possible, and also to permit the use of a pilot of larger diameter than could be secured by bushing the spindle.

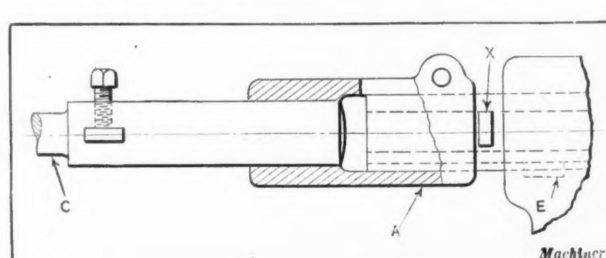


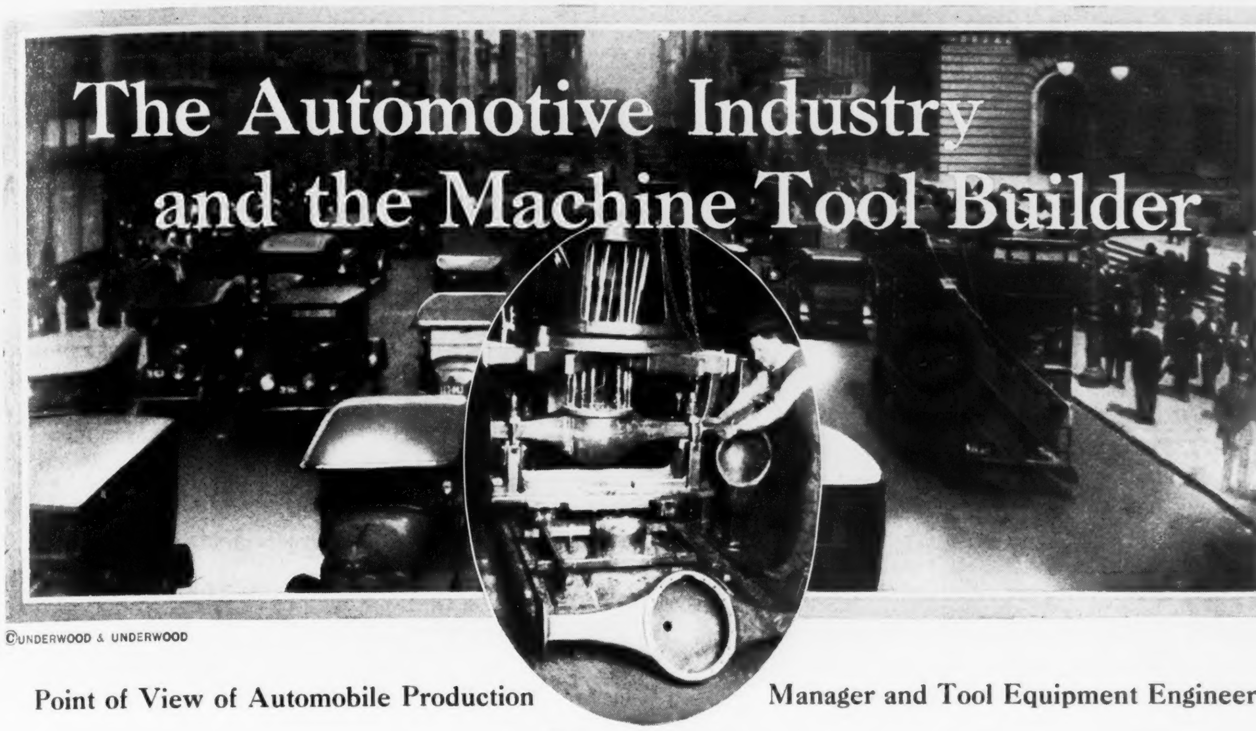
Fig. 2. Boring-bar used in boring Hole in Gear Blank

Power feed was secured by placing a piece of cold-rolled steel, ½ by 1½ by 8 inches, in the toolpost of the lathe, and bringing it into contact with the end of the sleeve A at point X, so that the tailstock could be fed forward on the ways of the lathe. The tailstock binder or clamp was, of course, adjusted to serve as a gib. Two cutters were used, one for roughing and one for finishing. The time required to rough- and finish-bore one of the gear blanks was approximately one-half hour.

* * *

The Society of Automotive Engineers, in recording the progress made during the past year, calls attention to the fact that approximately 200 technical papers were presented at the national and section meetings. The average attendance at the national meetings exceeded 400. Fifty-four standards were adopted, and nearly 1000 requests for information were given attention by the society's research department. The total membership is over 5600.

The Automotive Industry and the Machine Tool Builder



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Point of View of Automobile Production Manager and Tool Equipment Engineer

Second Article

As stated in the October number it was explained that MACHINERY has obtained, with a view to aiding the machine tool designer and furthering the cooperative work between the machine tool and the automotive industries, numerous suggestions from production managers and equipment and tool engineers in the automotive field relating to possible improvement of machine tool equipment for the automotive industry. These suggestions are published in two articles, of which this is the second. In addition, there will be an article giving information obtained from machine tool builders, stating their ideas as to how the automotive industry can best take advantage of the services rendered by the machine tool industry.

In October MACHINERY the question that seems to be uppermost in the minds of equipment engineers—whether single-purpose or standard machines should be used—was dealt with. Other subjects treated were: The need for simple standard production machines, new types of machine tools needed, cam feeds on production machines, equipment needed for the service shops, suggestions for improvements in the design of machine tools, provisions for motor drive, lubrication of machine tools, and control of the cutting lubricant. The present article will deal with the maintenance problem in the automobile shop, methods of selecting machine tools, cooperation between salesmen and equipment engineers, qualifications of salesmen and purchasing agents, and the problem of production estimates. In conclusion, the automotive engineer's view of the weakest spot in his own industry will be recorded.

The Maintenance Problem

The cost of maintenance of machine tools in automobile plants is one of the heavy items of expense, and it is natural that this should be so, because in no other industry is the service required from machine tools so strenuous as in this field, and the class of labor employed has often very little understanding of the proper use of the machines. Therefore, the equipment engineer is naturally anxious to obtain machine tools with such features of design as will reduce the maintenance cost as far as possible. In one of the large automobile plants, the cost of maintenance of the machine tool equipment averages annually 10 per cent of the first cost of the equipment. Expressed in definite figures, the maintenance cost runs from $30,000 to $40,000 a month in a plant employing 7000 men. Among the details mentioned in machine tool construction that add especially to the maintenance expense are bearings—both sliding and rotating—gears, cams, and cone clutches.

Bearings and Bearing Troubles

Cast-iron bearings, where still used, are said to be a constant source of trouble, and bronze-bushed bearings are advocated for use in their place. In fact, one equipment engineer advocates the use of ball or roller bearings in machine tools in every place where such bearings are practicable. In one shop where a number of drilling machines are used, each having several cast-iron bearings, repairs are necessary practically every week. Adjustable bronze bushings, if they had been applied to the machines in the original design, would have remedied the trouble.

Sliding bearings are also subject to considerable wear, and if made from soft cast iron, they wear very rapidly under the continuous production service of the automobile plant. In one case, the ways of one machine wore down 1/16 inch in three months. One engineer advocates hardened steel ways for all horizontal sliding bearings that are exposed to cooling compounds. This applies to gear-cutting machines, lathes, and turning machines of all kinds where a carriage slides back and forth and where chips fall on ways exposed to cooling compounds. The ordinary compound has no lubricating qualities—in fact, it dissolves lubricating oil and produces a metal-to-metal contact between the slides. Thus the slides are lapped by the chips and frequent replaning and rescraping are necessary to obtain accuracy.

Production men in the automotive field generally, welcome every opportunity for cooperation with the machine tool builder and his representatives, but as a rule there is not enough contact between the actual designer of machine tools and the man in charge of production in the automobile shop. Often the production man can convey directly to the machine tool designer, suggestions for overcoming difficulties that the latter may not properly appreciate when they come to him second-hand, or sometimes third-hand, through the sales representative. Unfortunately, there still are a few automobile plants—but very few—where the machine tool salesman is not given an opportunity to come into direct contact with the men responsible for production, but has to deal entirely with the purchasing department.

In order to avoid this difficulty, one plant has been using mineral oil for cooling purposes, and while this oil costs a great deal more than the ordinary cooling compound, it is considered economical to use it in the case of expensive machine tools. In the same plant no soluble cooling compounds are used on automatic machines of any kind, nor on gear-cutting machines. The saving on the cooling compound would be less than the increased cost of repairs. It is suggested that by placing hardened steel plates on both of the sliding surfaces, this difficulty would be overcome, and the reconditioning of the sliding ways would be comparatively easy. It could be done at a cost of, perhaps, $10 instead of $200 or $300, and it would overcome one of the most serious maintenance difficulties on machine tools with horizontal slides.

Proper lubricating systems also have a very important bearing upon the maintenance cost. Machine tools, it is held, should be lubricated like automobiles having a self-acting lubricating system.

Maintenance of Gearing

In many plants the greatest difficulty seems to have been with gears and gear-boxes. Although cast-iron gears are not frequently met with in machine tools at the present time, there have been a number of cases where special machines have been built with cast-iron gears; and many of the older machines, of course, are still provided with these gears. In one shop, a few cast-iron gears are replaced every week with steel gears, because the former wear too quickly and strip after wear. Generally, a machine ought to stand what the tools used in it will stand, but in some cases the gears are found too weak and are ruined by overloading. Heat-treated steel gears eliminate these difficulties, especially if they are carefully inspected before being placed in the machine to detect any defects or flaws in the steel that may have been caused by the heat-treatment, or that are present in the material.

Sliding bearings are subject to considerable wear, and if made of soft cast iron, they wear very rapidly under the continuous production service of the automobile shop. In one case, the ways of a machine wore down 1/16 inch in three months. Hence one equipment engineer advocates hardened steel ways for all horizontal sliding bearings that are exposed to cooling compounds, especially on gear-cutting machines, lathes, and turning machines of all types where a carriage slides back and forth on a bed and where chips fall on ways exposed to cooling compound.

Cams and Cone Clutches

For cams, also, cast iron should be avoided; generally speaking, all manufacturing machines intended for the automobile industry should have hardened steel cams. In the case of worm-gearing, even when the worm-gears are made of bronze running with steel worms, frequent replacements are necessary, apparently because the form of the teeth in the gear is not correct for steady, hard service. Careful study of proper means for cutting the worm-gearing would help to eliminate this difficulty. Cone clutches, also, frequently give trouble, and should generally be avoided in machine tools. One maintenance engineer claims that bearings and clutches account for 90 per cent of all the maintenance work.

Sometimes the maintenance work is increased by the fact that machine tools are not as thoroughly tested out before leaving the builder's plant as would be desirable. Responsibility for this, however, the automobile engineer generally assumes himself, because he admits that he is in such a hurry for his new equipment (which he often orders too late) that he does not always give the machine tool builder a chance to try it out thoroughly before it is shipped.

Another important source of maintenance expense has been the frequent attention needed by grinding machine spindles. Lately, however, machines have been brought out with very heavy spindles and bearings well protected and easily adjustable. These improved spindles obviate the former maintenance difficulty, and in some cases have been run a whole year without attention.

In drilling machines with several spindles, either of the gang or multiple-spindle type, the possibility of quickly removing one spindle and replacing it with another, without disassembling the machine itself, has proved a valuable feature, as production is interrupted for but a brief period.

Methods of Selecting Machine Tools in Automotive Plants

The methods whereby machine tools and other shop equipment are selected vary in different plants. In some shops the equipment is determined upon by a tool committee, while in others, the selection is left almost entirely to an individual, generally the production manager or the equipment engineer, and his assistants.

In a large plant where the tool committee system is used, this committee consists of the production engineer, the tool engineer, the superintendent of manufacturing, the superintendent of assembly, the chief inspector, and the general foreman of the machine shop. These men, after having agreed upon their recommendations for new equipment, submit it for final approval to the works manager.

In another plant there is a methods and equipment department, the purpose of which is to investigate all new machines and methods coming to its attention that appear suitable for the work in the shop. Careful time studies and production and cost estimates are made, and reports prepared to show definitely whether or not the buying of new equipment will prove an economical investment. The head of this department is solely responsible for the selection of new equipment, submitting his final recommendations directly to the works manager.

Contact between Production Department and Machine Tool Salesmen

In most plants the machine tool manufacturer or his sales representative is given an opportunity to deal directly with the production or equipment department. Of late there has been a closer contact between the machine tool builder and the men responsible for the equipment in the automobile plants than was formerly the case. The machine tool builders more frequently send their engineers to the automobile plants to learn definitely about the problems of the automotive shop. The result of this cooperation has been a rapid development of machinery especially suitable for the automobile shops, and greater harmony in the dealings between the two industries.

In a few plants the machine tool salesman is not given any opportunity to come into direct contact with the men responsible for production, but has to deal entirely with the purchasing department. Where the purchasing agent is an experienced mechanical man, this practice is not so detrimental, but in one case, at least, where the salesman is refused access to the shop and to the men responsible for production, the purchasing agent is inexperienced in mechanical methods, and as a result, dealings with this company are extremely difficult, and the proper cooperation between the machine tool builder and the production department of the plant are impossible. Most equipment engineers state that the machine tool builder shows great eagerness to cooperate with the automobile manufacturer, if given an opportunity, and when there is lack of cooperation, the automobile plant is generally at fault rather than the tool manufacturer.

The Qualifications of Machine Tool Salesmen

In some instances the equipment engineer complains that the salesmen calling upon him are not properly informed. To quote verbatim one of these engineers: "Lack of competent salesmen, who can give the production man real information about the machine tools they are selling, is one

of the difficulties with which we have to contend; some salesmen either do not know what their machines will produce or are unwilling to go on record for fear that their statements will be taken as a guarantee. If better salesmen were employed, the production men would be more anxious to go into details with them and give them an extended interview."

Fortunately, this view of the machine tool salesman is not general in the automobile industry. Most production managers state that the manufacturers' representatives know their business thoroughly, and one of them said that he did not know whether salesmen who were not so well informed as they ought to be were as numerous as purchasing agents who lack the proper background for buying machine shop equipment. "It is difficult," he said, "to say whether it is more discouraging for the production manager to try to deal with a light-weight salesman, or for the thoroughly informed and competent salesman to be forced to deal with a representative of the purchaser who does not understand anything about the equipment that the salesman represents."

Need for Careful Study of Production Problems

On the whole, the consensus of opinion is that the men who sell machine tools in the automotive industry are well informed on mechanical matters. In most cases, the manufacturer, realizing that the salesman will get into direct contact with the production engineers, sees to it that a man who can speak to them in their own language and who understands production problems is sent to represent his firm.

On the other hand, it is evident that unless a complete study is made of the methods and production problems in the automotive shops, neither the salesman nor the manufacturer of machine tools can have a thorough appreciation of what the high-production pressure of the automobile plant really means. It is entirely different from the production problems either in the machine tool shop itself or in other shops with which the machine tool builders ordinarily come into contact. The production men in the automotive field, therefore, welcome every opportunity for cooperation with the machine tool builder and his representatives, in order that their problems may be thoroughly understood. There is not enough contact, for example, between the actual designer of machine tools and the man in charge of production. Often the production man could convey directly to the machine tool designer suggestions for improvements that he may not properly appreciate when they come to him second- or third-hand through sales representatives.

If the designer were given an opportunity to obtain first-hand the production man's point of view and to gain a thorough knowledge of the production methods in the automobile shop, the result would doubtless be advantageous both to the machine tool builder and to the automobile plant. There are a number of machine tool manufacturers who take advantage of this opportunity for broadening the experience of their designers. The same applies to the demonstrators who install new machine tool equipment. These men are always good mechanics, but sometimes they are not as familiar with the high-production methods of the automobile shops as would be desirable in order to make them of the greatest value to both their employers and the purchaser.

The Problem of Production Estimates

The production manager frequently find it difficult to obtain accurate production estimates. This is not due to any attempt to overestimate the production on the part of the machine tool manufacturer, but rather to the fact that the machine tool builder sometimes overlooks the actual conditions in the automobile plant, the class of help employed, and the rigid requirements in regard to inspection. Many machines will produce in accordance with the production estimates when operated by the builder's own men, either in his own plant or in the automobile shop, but when the machine is in the hands of the unskilled class of operators that by necessity is employed in the automobile shops, they may not always meet the expectations. For this reason machines intended for the automotive industry, and especially those for the larger plants in this field, should be designed with the fact in mind that they are to be operated by unskilled labor, and the most important feature in their design should be simplicity of operation and freedom from any features that are easily damaged or put out of operation through ignorance or carelessness.

In making production estimates, the machine tool manufacturer must also consider the variations in materials that are likely to be met with in the automobile shop. Sometimes the design of the part to be operated upon may not permit of the high speeds or feeds of which the machine would be capable, and this must be taken into consideration in making production estimates. The standards of finish and tolerances in different shops also vary to such an extent that a production estimate that may have been found to be all right for one plant may not be correct for another. Because of all these factors, which are largely dependent upon the conditions in the automobile plant itself, one well-known machine tool builder refuses to guarantee production and merely states that sample pieces, such as furnished by the purchaser, have been machined in a given time in the builder's own shop.

During recent years there has been closer contact than formerly between the machine tool builder and the men who are responsible for equipment in the automobile plants. The machine tool builder now frequently sends his engineers to the automobile plants to learn definitely about the problems to be dealt with. The result of this cooperation has been a better understanding of automotive production problems on the part of the machine tool builder, a rapid development of machinery adapted for the automotive shop, and greater harmony in the dealings between the two industries.

An Example of How the Shop Conditions Affect the Production Estimate

As an example of the difficulty of making accurate preliminary production estimates may be mentioned the case where one manufacturer promised that his machine would complete the work required on twenty pieces an hour with two operators. As a matter of fact, it requires four operators and the production is only from twelve to fourteen pieces an hour. This is a perfectly satisfactory production as compared with former methods, but the reason that the manufacturer miscalculated was because he was unfamiliar with the conditions in the automobile plant directly affecting the work. He overestimated the speeds and feeds most economical for continuous production when tool grindings were considered, and the ability of two men to lift and carry the heavy parts and place them in the machine.

In practically every case where production estimates have been too high, it is because too high speeds and feeds have been assumed. There is no question but that feeds and speeds could be maintained, and the production estimates in that case would prove correct, but in many cases this could be done only by frequent tool grinding, the cost of which would outweigh the saving due to the increased production. As a matter of fact, the automotive industry itself has been mainly responsible for this tendency toward increasing production at all costs, and ignoring other factors of expense connected with it. Cases are on record where the actual cost per piece has been reduced by considerably increasing—in one case even doubling—the production time. The savings were due to decreased tool cost, decreased maintenance cost, and the reduction in spoiled work.

In regard to the service rendered by machine tool manufacturers, it has been said that while this is excellent in regard to special and single-purpose machines, it is not so good for standard machine tools. But why should a buyer expect service with standard machine tools? It is generally assumed that the buyer of such machines knows how to use

them and should require no further assistance in connection with them. The fact should not be overlooked that the price of standard machine tools does not include any margin for service, because service should not be considered necessary.

The right attitude toward the buying of machine tools was expressed by one equipment engineer in saying, "We expect good machine tools, we expect good service, we expect the machines to function as represented, and we do not consider the price asked by the machine tool builder for his product too high. The machines in this plant are earning all that they cost."

Operating Conditions in the Automobile Plants

Through personal interviews we obtained the opinions of over forty of the production managers and equipment engineers in the leading automobile plants in regard to what they consider the weakest spot in the operation of the automotive plants themselves. We asked the same question, by correspondence, of over one hundred similarly situated engineers in as many plants throughout the industry. Many of the replies received were similar in nature, and we will therefore quote only those that bring out different points. Some engineers are very blunt in expressing their opinions, and the editor can take no responsibility for the statements other than to insure that they properly record the opinions expressed.

Said one engineer, "The weakest spot in our industry is that we have been production crazy. We have sacrificed everything to production, and in many instances the haste with which we have tried to accomplish things has caused excessive waste. We want the parts today, the materials for which are to be available tomorrow."

This statement, however, although made by a well qualified man inside the industry, should not be taken too literally, because after all, while there doubtless has been a great deal of waste in the automobile shops, the tremendous advance made by the industry has partially been due to the enthusiasm and energy that characterizes the entire automobile field. You cannot engage in so great and vast an enterprise and develop it into one of the greatest industries of the United States in a period of hardly more than twenty years without making some mistakes, and we feel that the industry has accomplished so much through its eagerness and haste that it may well be forgiven for any mistakes and waste that may have accompanied it.

The vice-president and production manager of one of the large truck corporations states: "The weakest spot in the manufacturing practice of the automotive industry in general is uneven production, and relief can only come when the sales departments are able to distribute the product more steadily each month throughout the year."

The chief engineer of a company building one of the best-known high-grade cars in the United States made the following statement: "The weakest spot in the manufacturing practice is the tendency to work to wider limits in order to increase production and lower costs, thus tending to cause greater loss by scrapping material or lowering the standard of quality."

The Effect of Unskilled Labor

A production manager complains, in the following words, about the unskilled operators employed: "While most machines in the automobile shops today are up-to-date in every respect, the operators of these machines do not know anything about how to handle them, except to start and stop them, load the jigs and fixtures, and remove the work. If anything happens to the machine, even though the cause may be very simple, they must let the machine remain idle until someone can be called who understands the first principles of machine tool operation. This retards production and in some cases jeopardizes the reputation of the machine tool builder, because production is not maintained on the machine; whereas, production could easily have been maintained if the operator had had the slightest understanding of its operation. To overcome this difficulty, the machine tool builder must make a careful study toward the simplification of all machine tool elements with which the operator has anything to do, especially gear-shifting mechanisms, so that the most inexperienced operator can handle them."

The Importance of Quality in Small Tools

The same engineer, in commenting upon the tooling equipment in some automobile shops, states: "A machine tool, to give one hundred per cent production, must be equipped with small tools having one hundred per cent efficiency. I have found several automobile shops in which the management is very generous in making large appropriations for the installation of new and modern machine tools, but where it is difficult to obtain the required number and quality of smaller tools that have to be used in conjunction with the machines, and where the purchasing department, when it is eventually compelled to buy small tools, obtains them as cheaply as possible, instead of getting the very best quality." The solution of this problem lies evidently within the automobile plant itself, and the manufacturers of small tools must carry on an educational campaign similar to that which has so successfully been carried on by machine tool manufacturers. The purchasing departments of most automobile plants now realize that efficient machine tools are necessary, but in some cases they are still trying to save on small tools.

Another production manager considers the weakest spot in the manufacturing practice of the automotive industry lack of cooperation between different departments, especially between the tool engineering department and the production department, which in some cases, instead of co-operating, appear to be hostile to each other. This weakness could be obviated by having the two departments under one head, as they ought to be, because they are too closely connected to be separated. In fact, in a great many of the leading automobile plants the production and tool engineering departments are conducted as one department, and the success of this method is obvious.

In making production estimates, the variations in materials that are likely to be met with in automobile shops must be considered. Sometimes the design of the part to be operated upon may not permit the high speeds and feeds to be used of which the machine is capable; this, too, must be taken into consideration in making production estimates. Often the machine is capable of the high speeds and feeds estimated, but these speeds can be maintained only by frequent tool grinding, the cost of which outweighs the savings effected by increased production.

More Power Press Equipment Could be Used

The same engineer points out that there is less use made of power presses in many automobile plants than there should be. Some automobile plants are well equipped with metal stamping machinery, but the majority are not. The reason, he states, is that many tool engineers have comparatively little experience with punch and die work; hence, there are automobile concerns that are still producing parts in regular machine tools by the jig and fixture method, at the rate of from six to twelve pieces an hour, where equally satisfactory parts could be made by dies in the power press at the rate of thousands a day. "I would, therefore, say, that one of the weakest spots in some automobile plants is their lack of experienced die engineers."

Another production engineer makes the following statement: "The small use made of coining presses is perhaps a weakness. Coining presses cover a wide range of work in the automotive industry, and can be used to advantage for many purposes. Some automobile plants are now using

coining presses to some extent, but the field for this machine is a large one and its possibilities have not yet been anywhere nearly fully developed."

Improved Inspection Methods Needed

An engineer connected with one of the largest automobile engine builders considers the weakest spot in automotive manufacturing practice to be the inspection system. "Most inspection systems in automotive plants," he states, "seem to have for their only purpose to find out that the piece is wrong after a great quantity of wrong pieces have been made. A really efficient inspection system should not merely find out that a thing is wrong after it is made, but should, as far as possible, prevent errors from being made. To accomplish this, the inspection should be in charge of the man at the head of the department, and he should be held responsible for the quality of work passing from his department and for all work spoiled in it. Such a system has been installed in some plants, thereby displacing a great many inspectors who merely passed upon the work after it had been completed." The system of making the foreman in charge of the department its chief inspector and holding him directly responsible for all results is said to have improved the quality of the product, reduced the amount of scrap, and decreased the inspection and production costs. This is really a return to first principles in manufacturing, making each department a unit within itself.

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DOES TRADE TRAINING PAY?

By E. H. FISH

Ten years ago the Worcester Boys Trade School, Worcester, Mass., graduated its first class of twenty-seven boys, and since then it has regularly sent out as many or more each year, making a total of nearly five hundred graduates. To determine how they have fared, an attempt was recently made to reach as many as possible of the graduates and non-graduates who left the school five years or more ago. Except during the war period, there has been a remarkably high percentage of employment among both. Out of two hundred boys taken at random, only one reported having been out of work over six months with the exception of those who were sick.

Comparison of Wages Earned by Graduates and Non-Graduates

Of a group of one hundred graduates and an equal number of non-graduates, it was found that the average wage of the graduates during their first year after leaving school was $18.93 per week, and the wage of the non-graduates of the same class during the same calendar year, $12.67 per week. However, of the non-graduates forty-eight had attended the school less than a full year; the average wage of these during the first working year of the graduates was only $10.83. It is probably fair to assume that these boys profited little from the training they received and that their status is no different from that of the average boy who does not train himself for any particular thing. Comparing the short-time boys with the graduates, the cash profit of the graduates during their first year out of school was $8.10 each per week or $421 per year.

The investment made in the school by the city and state was at the rate of about $150 per year per pupil or about $600 for the four-year course. Judging from the wages of the non-graduates, the graduates could have earned approximately $2200 during the time they attended school, making a total investment of about $2800. On this investment the net gain of the graduates of $421 during the first working year, represents a dividend of 15 per cent, which is admittedly a good return on the money invested.

Wage Comparisons for Succeeding Four Years

During the second year, the forty-eight non-graduates who attended school less than one year earned only $16.30 per week, as against $23.65 earned by the graduates. The gain for the graduates amounted to $7.35 per week, or a net return for the year on the investment of 13.6 per cent. Returns for the third year showed an average weekly wage of $18.81 for the forty-eight short-time boys, and of $29.70 for the graduates. In this year the return on the investment was 20.2 per cent, which clearly shows the advantages of the training.

The fourth year showed a wage of $8.16 per week more for the graduates, and a return on the investment for the year of about 15 per cent. In the fifth year the boys who attended the school less than one year earned $26.40 per week and the graduates $35, a gain of $8.60, or a dividend for the year of 15.9 per cent on the investment. The total average gain in salary for each graduate during the whole five years was about $2241, and the average return on the investment, 16 per cent.

No records have been kept of students who attended the school less than six months, but it is likely that some good resulted even to those boys from the little training they received. The actual gain to the graduates is probably greater than it appears, because the attendance of the boys who work is seldom as steady as those who go to school. Thus the average non-graduate would not have earned the amount credited to him during the four years that the graduate was attending school. The records indicate many more changes in jobs for the non-graduates than for the graduates. The former are either less desirable or else their desire for changes occasions their frequent movement from job to job.

Value of Trade Education to the Community

If we are to consider the value of trade education to the community, the case of the graduates becomes still stronger because the community is concerned not only with that part of the cost which comes out of taxes but also with the improved character of the boys who attend the school. This is somewhat intangible, but that there is a great gain here, will be vouched for by everyone who has run across any considerable number of the graduates. Coming back again to the financial side, it is safe to assume that each boy has a fair prospect of working for forty years after graduation. At the rate of their progress during the first five years they should make about $17,000 more during this time than their non-graduate friends. If they should put these gains into a savings bank at 4 per cent interest, the amount would almost double exactly in that time, giving a total profit of $34,000. Another surprising thing shown by this investigation is the small number of graduates who have left the trades for which they were trained. Out of the one hundred graduates considered, one was sick for a long time and had to take a job as a bookkeeper, two are pursuing still higher education, one is a farmer and another is a policeman, but the rest are following their trades.

* * *

The Department of Commerce has estimated that at the end of 1923 American investments abroad amounted to about $8,000,000,000, whereas foreign investments in the United States amounted to about $3,000,000,000. The balance in favor of the United States, therefore, was about $5,000,000,000. Ten years ago it is estimated that foreign investments in the United States exceeded American investments abroad by from $2,000,000,000 to $2,500,000,000. In addition, foreign governments owe the United States Government approximately $12,000,000,000. As these debts of foreign nations to us cannot possibly be paid in gold, they must, if paid at all, be paid through the importation of foreign-made goods into the United States, a fact that must be faced squarely and should be clearly understood. The Dawes plan for Germany involves exactly that proposition—that Germany is to pay the indemnities by the products of her industries, as the payments can be made in no other way. In fact, there is not gold enough in the world to pay the national debts of the nations that took part in the World War were payments to be expected in gold.

Testing Materials in the Laboratory

How the Metallurgical Laboratory Maintained by the Bullard Machine Tool Company Controls the Quality of the Materials Used in Building Machines in the Shop

UPON the service rendered by a machine tool depends the reputation of the manufacturer. The design may be praiseworthy and the machine may give a high production for a considerable period of time, but if it does not stand up well under prolonged use, the reputation of the machine and its builder will suffer. The quality of any machine depends primarily upon the materials used in its construction; parts may be machined to close limits, but if the materials from which they are made are not suitable for the purpose, the parts may not be strong enough to stand the strain imposed on them or may wear quickly and lose their accuracy. As the quality of the machine is influenced to such an extent by the materials from which it is constructed, a close check is necessary on all materials.

This article describes the work of the metallurgical laboratory maintained by the Bullard Machine Tool Co., Bridgeport, Conn., in keeping a check on all raw materials used in the construction of their machines. By means of such a laboratory and a well organized inspection department, it is possible to insure that each machine that is built will give the length of service expected of it.

Materials Purchased According to Specifications

All pig iron and steels are purchased according to standardized specifications, and when these materials are received at the plant they are checked with the analyses specified. These specifications cover the composition of the material, finish, service required, terms of inspection and rejection, marks of identification, etc. On a second page are given, in the case of steels, various heat-treatments that should be given the steel when it is to be used for certain purposes. Specifications for structural steels also show graphically the properties of the steel when drawn at various temperatures after hardening. By means of this chart, when the steel is to be used for a given purpose, it is an easy matter to determine the ductility, strength, and hardness that may be expected from it for the various tempers. These graphical charts are made up for the steels after conducting about twenty separate physical tests.

Briefly, the work of the laboratory consists of making chemical tests on pig iron, coke, limestone, and other foundry supplies, and both physical and chemical tests on plain carbon steels, alloy steels, carbon tool steels, high-speed steels, forgings, brasses, bronzes, and babbitt metals. Records are kept in the laboratory of all tests, and reports are made to certain departments, as will be explained. The purpose of the laboratory, however, is not only to insure that the quality of materials ordered and paid for is actually received but also to conduct researches with a view to improving the machines built by using more suitable materials.

Testing Foundry Supplies and Output

With each purchase of pig iron there is supplied a card on which is given the blast furnace analysis, and a chemical test is made in the laboratory to check this analysis. The chips for the test are taken from about four pigs of each ton. Steel scrap bought outside for foundry use is more or less selected. A carload of fairly classified scrap is usually bought from one concern, and a test on chips taken from several pieces of this scrap will be fairly accurate for the entire lot. Only chemical tests are made in this instance.

Coke is tested for the percentage of moisture, ash, sulphur, etc., about a bushel being taken from a carload, pounded down, quartered, and repounded and quartered until about 25 grams of fine powder is obtained from which the analysis is made. The amount of ash must not be over 10 per cent, nor the sulphur content over 1 per cent. Limestone is checked for the amount of lime, silica, etc., that it contains. Records of tests on foundry supplies are made on a red card (shown in Fig. 1) which is kept in a laboratory file. The card illustrated gives the composition of a carload of pig iron.

From each melt at the foundry there are cast two test bars, 1 inch square and 18 inches long, for the use of the laboratory, one bar being used for a tensile test and the other for a transverse

METALLURGICAL DEPT.

DATE 4-28-24. LABORATORY REPORT NO. 458 F.

MATERIAL Thomas Vanadium Pig Iron, CAR NO. C. N. J. 85048.

Carbon	4.31 %
Silicon	2.42
Sulphur	0.028
Phosphorus	0.79
Manganese	0.59

Fig. 1. Red Card on which the Laboratory keeps a Record of all Foundry Supplies analyzed

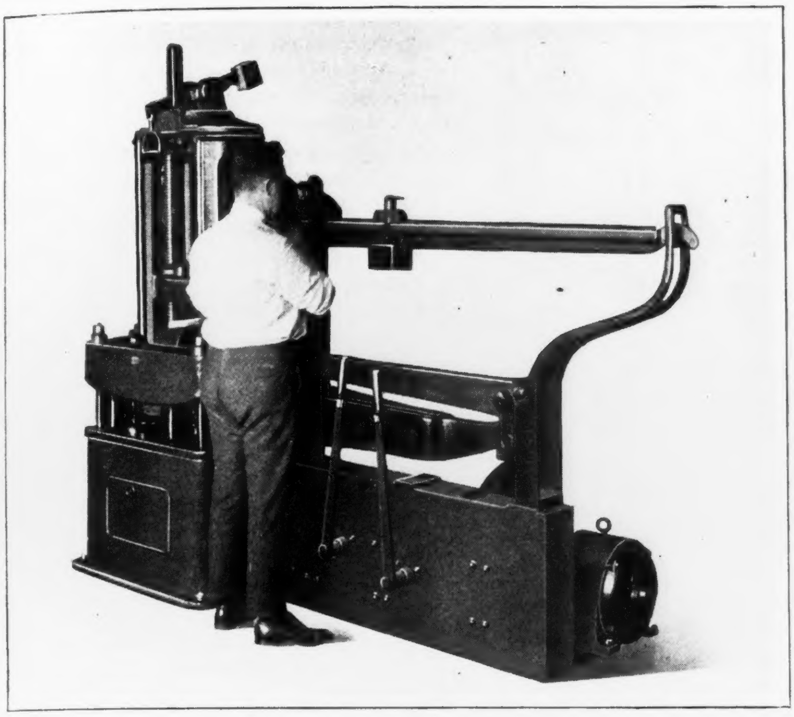


Fig. 2. Conducting a Transverse Breaking Test on a Specimen Bar cast from a Foundry Melt

test. Chips for the chemical tests are taken from both bars after breaking. The strength tests are made on the Riehle 100,000-pound testing machine illustrated in Fig. 2. Certain strength values have been adopted for the various foundry mixtures, and these physical tests show whether the standard strengths are actually obtained. Upon the basis of these tests, experiments can constantly be made with a view to producing as strong castings as possible commensurate with good machineability.

After the strength tests, a machineability test is made on the specimens under a bench drilling machine equipped with a small-diameter drill. A definite weight is applied to the spindle to furnish the feed, and with the spindle driven at about 1750 revolutions per minute, the time taken to drill through the one-inch bar is taken as a standard of the machineability. Maximum and minimum time limits are specified for each bar mixture. If the time of drilling is too short, the castings made from the mixture will be too open-grained and not strong enough, whereas if the time is too long, the desired machineability is not obtained. The drill used in this test is ground at the point to a certain angle, and used only once between regrindings. This test gives a definite clue to the hardness of the castings from each melt. However, an additional test is made on the specimen with a Brinell hardness testing machine.

Complete chemical analyses are then made from the drillings, which are too involved to be explained in an article of this nature. It may simply be mentioned that the heading illustration shows the titration apparatus used for volumetric analysis. A report of the tests is made to the foundry on every melt, the white form shown in Fig. 3 being used for this purpose. It will be seen that the foundry superintendent receives from this report complete information concerning the tests. A copy of this report is also kept on file in the laboratory. Near the bottom of the card is given the weight of the various materials used for the charge from which the specimen was cast. Two or three times a week two specimen bars are taken at the beginning, middle, and end of a melt, and tests made on all six specimens.

Checking Steel Shipments

When a shipment of steel is received at the plant, whether it consists simply of a bar of high-speed steel or a large order of structural steel bars, a yellow tag of the type shown in Fig. 5 is filled out by the receiving clerk, who then attaches the top stub to the order and sends the lower and main portion of the tag to the laboratory, together with the purchase order number, and any other essential information, and a sample cut from a bar of the lot. Tool and high-speed steels are sent to the stock-room, and structural steels, such as chrome-nickel and plain carbon, to the steel racks in the yard.

Drillings are taken from the specimen of each lot of steel for a complete chemical test, and hardness tests are conducted on samples of all chrome-nickel steels and forgings. However, there is no machineability test, as in the case of iron castings. Fig. 4 shows the equipment used to check the carbon content of steel. Steels are never bought at random; one make and analysis and a substitute are adopted for each particular purpose, and these steels are used for that purpose until others are found that are more desirable.

Although chemical tests are made on each lot, physical tests are periodical. They are conducted to determine the elastic limit, tensile strength, elongation, reduction of area, etc. For these tests, the specimen is first machined to the dimensions shown in Fig. 6, and then hardened and tempered. The physical tests are so extensive that the data cannot be contained on a simple record card, and so they are embodied in letter form and filed in the laboratory. With each purchase of stock, the mill is asked to supply the number of the heat in which the steel was melted, and when the shipment is received, the metallurgist checks the heat number to see whether material from the same heat has been received in the past. In the event that it has been, a second check is obviated. A heat number is given on the tag in Fig. 5. While the analyses are in process, the material is also looked over for physical defects, such as pipes and seams. If the material passes this inspection and the analysis is found to be correct, the tag is punched in the column marked "Accepted" as shown; otherwise it is punched in the column marked "Rejected."

A record of all steel chemical analyses is made on a blue card such as shown in Fig. 7, which is kept in the labor-

FORM M-150 Date 4-16-24

REPORT OF TESTS

Report No. 447 F.		Sample No.	C-1.
Cast Iron	Foundry Dept.	Date	4-15-24
Physical Tests		Analysis of Melt	
Tensile Strength lbs. per Sq. In.	31,290	Combined C	0.55 %
Transverse " " " " "	3,120	Graphitic C	2.80
Machineability 38 seconds.	Deflection 0.19	Si	2.00
Remarks Gray Iron, Regular Mixture.		S	0.09
		P	0.55
Coke 200 Lbs.		Mn	0.49
Pig Iron 400 lbs. 2X Thomas Iron, 400 lbs. 2X Susquehanna Iron,			
Cast Iron Scrap 600 lbs. Foundry Scrap, 600 lbs. Foreign Scrap.			
Steel			
Limestone			

Fig. 3. White Form on which Tests conducted on Melts are reported to the Foundry and which is filed in the Laboratory

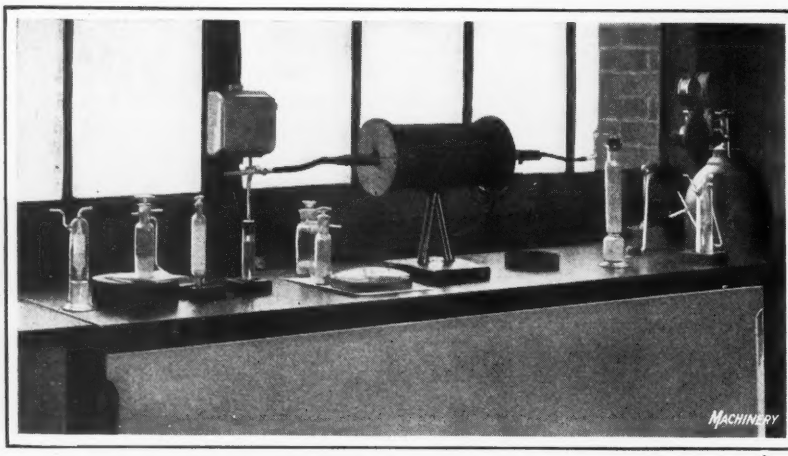
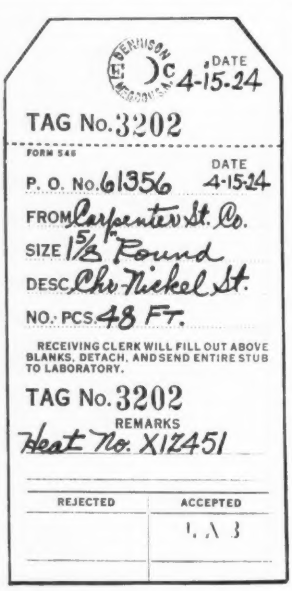


Fig. 4. Equipment used in determining the Percentage of Carbon in Steel and Iron

atory for future reference. After steels have been accepted by the laboratory, each bar is painted on the ends for identification purposes in the yard racks, and the racks are also marked to make doubly sure that mistakes will not be made in filling requisitions. Much of the time the metallurgist makes numerous investigations of new steels recommended by mill salesmen.

Before an order of tool steel is accepted for use, it is thoroughly examined for surface cracks and checks, an examination that has been found very satisfactory for revealing defective tool steel and definitely placing the responsibility on the supplier. For this inspection, the steel is swabbed with machine oil and set aside for at least ten hours. It is then sand-blasted, and during this operation all surface oil and scale is removed. When the operation has been completed, all dangerous cracks or checks will be visible on account of the oil remaining in them. This method is a simple one, but it has been found very effective. Tool steels are also given chemical and some physical tests. Experiments are occasionally made on high-speed steels to determine their cutting capacity.


DATE 4-15-24

TAG No. 3202

FORM 548

P. O. No. 61356 DATE 4-15-24

FROM Carpenter St. Co.

SIZE 1 5/8 Round

DESC Chr-Nickel St.

NO. PCS 48 Ft.

RECEIVING CLERK WILL FILL OUT ABOVE BLANKS, DETACH, AND SEND ENTIRE STUB TO LABORATORY.

TAG No. 3202

REMARKS

Heat No. X12451

REJECTED	ACCEPTED

Fig. 5. Tag made out for Incoming Materials

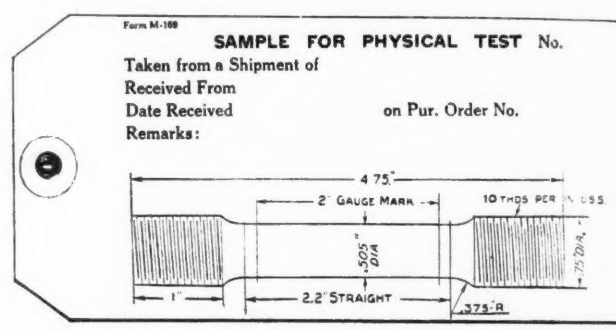
Examination of Purchased Forgings

Forgings bought from outside sources must have a Brinell hardness in accordance with Bullard maximum and minimum specifications. Drillings are taken from several forgings of a lot for a chemical analysis. If the forgings are too large to be conveniently taken to the laboratory, the tests are not made until chips can be obtained from the earliest machining operations. These chips are first washed with gasoline and then with ether, and finally dried thoroughly. Forgings purchased from steel mills usually have the heat number stamped on them, and from these numbers the metallurgist knows whether one or several tests should be made. No physical tests are made on purchased forgings, because if they agree to the composition specified, their approximate properties are known. Non-ferrous metals are checked principally for composition.

Laboratory Equipment

The equipment of the laboratory consists of a Riehle testing machine, Brinell and scleroscope hardness testing machines, bench drilling machine, drill grinding machine, balances, carbon combustion apparatus, electric muffle furnace, electric hot plates, electric water still, complete glassware for analytical work, and a large stock of chemicals. All solutions used for analytical purposes, the carbon train shown in Fig. 4, etc., are checked at the beginning of every day with standard samples obtained from the U. S. Bureau of Standards.

The value in actual dollars and cents of the service rendered by the laboratory to the company is in a measure indeterminate. However, it can be stated that the laboratory has saved a large amount of money by rejecting defective stock before any machining operations have been performed on it. In such cases even if the supplier does replace the defective material, there has been incurred a loss in time, wages, and overhead expenses. The greatest


Form M-169

SAMPLE FOR PHYSICAL TEST No.

Taken from a Shipment of

Received From

Date Received on Pur. Order No.

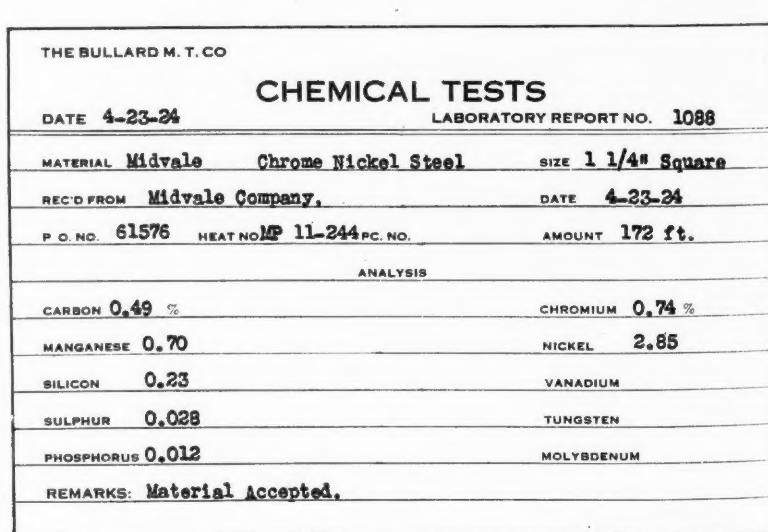
Remarks:

Fig. 6. Tag attached to Steel Samples machined as shown for the Physical Test

service of the laboratory, however, is that it so controls the materials used in building each machine that the company knows definitely what service may be expected, and the cost to the customer from constantly recurring delays due to the failure of parts, is eliminated.

* * *

The Simplification Committee of the sheet steel industry as the result of a survey of the varieties existing in this field, has prepared a tentative schedule of gages and sizes, which is now being presented to the industry for consideration. This schedule, if adopted, will reduce the number of items from 1819 to 261. All other sizes will be made special to order only.


THE BULLARD M. T. CO

CHEMICAL TESTS

DATE 4-23-24 LABORATORY REPORT NO. 1088

MATERIAL Midvale Chrome Nickel Steel SIZE 1 1/4" Square

REC'D FROM Midvale Company. DATE 4-23-24

P. O. NO. 61576 HEAT NO. MP 11-244 PC. NO. AMOUNT 172 ft.

ANALYSIS

CARBON	0.49 %	CHROMIUM	0.74 %
MANGANESE	0.70	NICKEL	2.85
SILICON	0.23	VANADIUM	
SULPHUR	0.028	TUNGSTEN	
PHOSPHORUS	0.012	MOLYBDENUM	

REMARKS: Material Accepted.

Fig. 7. Blue Card used for recording Chemical Tests made on Steels

THE BRITISH METAL-WORKING INDUSTRIES

From MACHINERY'S Special Correspondent

London, October 14

In the metal-working industries as a whole conditions have been somewhat disappointing during the last few weeks; some branches continue to show improvement, but in others a degree of stagnation is evident. The relative positions of the machine tool industry and general engineering have altered considerably; the machine tool industry was one of the last to benefit after the big slump, but at present it is holding its own with the more active sections of engineering.

The results of the Machine Tool Exhibition at Olympia were generally satisfactory. Substantial orders have, in many cases, been placed, but the chief results will not be apparent for some weeks, since they are contingent upon the realization of inquiries and recommendations made by responsible executives. The inquiries covered a wide field, and pointed to the urgent need of additions or replacements to facilitate production generally. The present stringent conditions as regards money will alone be responsible for any hesitancy in placing orders. An outstanding feature of the exhibition was the keen interest displayed in new British products, and the opinion was freely expressed that British manufacturers have nothing to fear from foreign machines of the ultra-manufacturing type. The keynote must be optimism, for if the inquiries should eventuate in anything like the promised volume, machine tool makers can look to a busy time ahead.

Apart from the experience of the exhibition, nearly all machine tool manufacturers are agreed that even during the last two months improvement has been noticeable. Competition, however, is exceedingly keen, and prices are not always profitable. A gratifying feature of present conditions is the gradual growth in the demand for standard machine tools. The shops that are equipped for building the heavier classes of machine tools are by no means idle, and fair activity is to be noticed in hydraulic machines and heavy testing machines. The demand for gear-cutting machines remains steady, and inquiries regarding gear-grinding machines are increasing.

In the automobile industry there is a growing demand for simple single-operation tools, and there is a contention that machine tool makers have not given as much attention to the requirements of the automobile trade in this direction as is warranted. The cost of one highly developed and elaborate machine would cover that of a gang of simple single-operation machines which, as a whole, is considerably more elastic than the elaborate type of machine.

Overseas Trade in Machine Tools

The Colonies and British Possessions generally continue to be the best overseas customers for machine tools; India, Australia, and New Zealand figure prominently in every return of exports. Under the government "Export Credit" scheme, some useful orders are being obtained from countries that might have been unable to get credit in purely private transactions. Russia has been a fairly good customer for machine tools during the last month or two, and in August took shipments to the value of £6500. Among other important foreign customers may be noted the Argentine Republic, which during the same month also took £6500 worth of machine tools. The exports to France in August amounted to £8000, and to America about £7000. Of the Colonies and Possessions, India bought British machine tools to the value of £25,000, Australia £15,600, and New Zealand £4600.

The total value of machine tool exports during August was £106,000, the tonnage being 880 with a value of £121 per ton. These figures show a decided fall, as compared with £146,950 and 1427 tons for July. On the other hand, the imports of machine tools showed an increase from £59,900 for 390 tons in July to £72,823 for 440 tons in August, the value per ton for the latter month being about £166.

The Engineering Field

Conditions in the engineering industry generally are patchy, and in certain localities there is a disconcerting increase of unemployment. Both home, and overseas railway orders continue to filter through. Locomotive builders are still receiving orders for locomotives in small batches. Although there is little home trade and a minimum of activity in overseas markets for textile machines, some orders are coming in. Makers of oil engines report a great improvement during the last two months, all sizes from the smallest up to 200 horsepower being in good demand.

With regard to the automobile industry, it may be said that works generally are far from being idle, even though the season is virtually at an end. In many cases manufacture is still on a heavy scale, and several of the best known makers of light cars continue to run day and night on the three-shift system.

The cycle trades, although not so brisk as the automobile trade, are in a very good position. Taken all around, the season has been one of the best they have ever had, and the orders from both home and foreign customers at present are much more satisfactory than at this time last year.

FIFTEEN PRIZES OFFERED BY MACHINERY

Fifteen prizes will be awarded by MACHINERY for the best articles submitted on

The Most Interesting Device or Method for Gaging, Measuring, or Inspection that I Have Ever Seen

Two prizes each will consist of MACHINERY'S Encyclopedia.

Two prizes each—ten volumes of MACHINERY'S Mechanical Library.

Four prizes each—five volumes of MACHINERY'S Mechanical Library.

Seven prizes each—three volumes of MACHINERY'S Mechanical Library.

Winners of prizes may select from the twenty-eight volumes of the library the books they prefer. If a winner of MACHINERY'S Encyclopedia already possesses this work, he may choose any fifteen volumes from the Mechanical Library. Regular space rates will also be paid for the prize-winning articles when published in MACHINERY, in addition to the prizes awarded.

Articles submitted may describe any measuring or gaging device that is not on the market as a commercial product; the description may deal either with the measuring device itself, with the method of using it, or both. The article may also deal with an unusual method of using a standard commercial measuring device, but in that case the method, and not the device, must be the feature of the article.

Manuscripts for this competition must be in the hands of the Editor of MACHINERY, 148 Lafayette St., New York City, on or before December 1, 1924. Articles that are not awarded a prize may, nevertheless, be accepted for publication, in which case they will be paid for at regular space rates. Manuscripts that are not published will be returned.

Current Editorial Comment

in the Machine-building and Kindred Industries

HOOVER'S CONSTRUCTIVE WORK

The Bureau of Foreign and Domestic Commerce, as reconstructed and greatly expanded under the direction of Herbert Hoover, has become a real aid to American industries. During the past four years numerous new activities have been undertaken. Sixteen new divisions have been created, each relating to an important branch of industry or commerce. Close cooperation has been established between the Bureau and many trade associations, and there are now working hand in hand with the Bureau, more than seventy-five committees selected by trade associations to represent their respective industries. Among the divisions created, each in charge of an executive with practical experience in foreign sales of the products pertaining to his division, are industrial machinery, iron and steel, electrical equipment, automotive products, and agricultural implements.

Under the present administration, the service that the Bureau is prepared to render in connection with foreign sales has been organized on a thoroughly practical basis. The Bureau has a complete list of foreign importers and dealers in all commodities throughout the world. This file contains detailed information on the class of machinery or product handled, data as to the financial responsibility of the dealer, names of American and foreign firms that he represents, and other information relating to his business that is of interest to an American exporter. The comprehensive information thus available enables the Bureau to assist American manufacturers in the selection of foreign agents.

The extent and value of this work will be realized when we know that the Bureau's files now contain information about 360,000 firms engaged in handling machinery and merchandise in all the countries of the world. In the fiscal year 1923-1924 the Bureau furnished 417,200 lists of names of dealers to manufacturers interested in foreign trade, and answered on an average 6000 inquiries daily on subjects relating to foreign and domestic commerce. The total cost of the Bureau is $2,600,000 a year, a small amount for the Government to expend in serving industries that pay the greater part of all the Federal taxes.

The credit for building up this valuable service belongs almost altogether to Secretary Hoover and to the able men he has gathered around him in this entirely new organization.

* * *

EFFECT OF QUANTITY ON METHOD

Many of our friends in the mechanical field request recommendations concerning machine tools or methods applicable to various manufacturing operations. This is a service that we desire to perform as effectively as possible, but we are often handicapped decidedly by lack of essential information. A common omission in these inquiries and a point of extreme importance in the selection of equipment or methods, is that relating to the volume of work to be done in a given time. Everyone experienced in manufacturing practice realizes that an approximate idea of the production rate is necessary in making specific recommendations about equipment or methods, so that this editorial is merely a reminder.

As an illustration of the vital relationship between quantity and method, consider the production of a small turned part. Ordinarily, work of this kind might be done either on an engine lathe, a turret lathe, or an automatic screw machine. In selecting the machine, quantity is the determining factor. The same principle applies to many other classes of equipment used in the machine-building industry; in fact, production rates established by commercial considerations affect machine tool selection more than any other factor.

Another essential point relates to accuracy. If quantity production and extreme accuracy are both demanded, it might be necessary to sacrifice speed to keep within the tolerances required. It is important, therefore, in writing either to MACHINERY or to machine tool builders to give complete information about these two important requirements.

* * *

THE COMMERCIAL SIDE OF DESIGN

That the cost of manufacturing a mechanical device or a machine part may reflect directly the merits of the designer's work, is a point not appreciated fully by many engineering students and younger draftsmen. The natural tendency of the inexperienced designer is to concentrate on the purely mechanical problems. Frequently the outcome is either a machine embodying complicated movements, or perhaps containing some part designed very carefully in accordance with stress calculations, but with little or no consideration for economical manufacturing methods.

The highest development in designing consists in reducing a mechanism or a part to the simplest form consistent with its intended use. A simplified design usually is less imposing than a more intricate one, but generally more practical. Simplification means more durable construction and usually lower manufacturing costs. The designer should bear in mind that many devices which appear to meet all mechanical requirements may be utterly worthless commercially. And in the final analysis the engineer and inventor must base his work upon sound business principles.

* * *

TESTING TOOLS TO DESTRUCTION

The only tests of cutting tools that are of practical value are those made under conditions similar to the usage they would be subjected to in the shop. Tests to determine what amount of abuse a tool will stand before breaking are of little value, except to indicate the limit of its durability, which should never be approached in ordinary use; for no one would intentionally operate a tool or machine until it breaks. The tests of real value are those that show how long a cutting tool may be expected to last if used under normal working conditions.

It may be worth knowing, for example, that a tool will stand up under a cutting speed of 200 feet per minute for five minutes, because that may indicate unusual qualities in the material from which the tool is made; but the user of the tool obtains little practical information from such a test. But if the tool can be run at 100 feet per minute for one hour before requiring regrinding, the test has established a record of its performance on one kind of work that is of direct practical application in everyday machine shop practice.

Occasionally it may be worth while to test tools to complete destruction—drills, for example, until they break, and milling cutters until the edges of the teeth chip off; but ordinarily the useful tests are those that duplicate the performance of the tools under normal shop conditions, running them at speeds and feeds such as an operator may be using day in and day out. The tool that lasts the longest under those conditions has established a record for use.

National Machine Tool Builders' Convention

THE twenty-third annual convention of the National Machine Tool Builders' Association was held at the Hotel Aspinwall, Lenox, Mass., October 8 to 10. At this meeting the officers for the coming year and three new directors were elected. O. B. Iles of the International Machine Tool Co., Indianapolis, Ind., was elected president; Frank N. MacLeod of the Abrasive Machine Tool Co., Providence, R. I., first vice-president; J. G. Benedict of Landis Machine Co., Inc., Waynesboro, Pa., second vice-president; and H. M. Lucas of the Lucas Machine Tool Co., Cleveland, Ohio, treasurer. Ernest F. DuBrul remains general manager of the association. The three new directors elected at this meeting are: H. L. Flather of the Flather Co., Nashua, N. H.; James E. Gleason of the Gleason Works, Rochester, N. Y.; and W. P. Hunt of the Moline Tool Co., Moline, Ill.

A number of addresses were made relating both directly to association matters and to general subjects of importance to the industry. The opening address by the president of the association, Ralph E. Flanders, manager of the Jones & Lamson Machine Co., Springfield, Vt., called attention to many of the problems concerning not only the machine tool industry, but the machine-building industries in general.

O. B. Iles, Newly Elected President of the National Machine Tool Builders' Association

The President's Address

In his address, Mr. Flanders pointed out that at present all indications point to an improvement in business. While some industries are still keenly feeling the depression through which we have passed, there are many favorable signs, one of the most important of which is that the conditions of the farmers of the country, as a whole, are more favorable than for several years past. The prosperity of the farmer was emphasized as a matter of concern to all the industries, because, after all, the tides of commerce rise and fall with the farmer's buying power, and he is the cornerstone of the nation's prosperity. "To the favorable aspect of agriculture," said Mr. Flanders, "we may add that of the financial situation. A prospective increase in the demand of consumer goods and an actual increase in financial equipment for meeting the demand cannot fail to have a salutary effect on our own future."

In regard to the political situation, it was pointed out that the effects of political changes are generally overemphasized. "Let us calmly and steadily do our duty as citizens, but let us neither place an undue importance on political aid nor be unduly concerned by political disturbance. Industry will find some way of continuing to function, *provided that it ties itself in with the needs of the social structure.*" In continuing his address, Mr. Flanders called attention to the relation between direct labor cost in manufacturing and overhead costs, pointed out the way in which the machine tool builder could best meet this situation, and referred to the best line of procedure to follow in regard to necessary improvements and developments in machine tool design.

Ethics in Business Management

Mr. Flanders further emphasized the need of definite conceptions of the ethics of business management, and referred especially to the code of ethics formulated by the Chamber of Commerce of the United States. In this connection he pointed out that a reading of the principles suggested by the Chamber of Commerce gives a clue to the deeper aspirations of American business. He especially emphasized that it is the duty of the industries in general, and of the machine tool industry in particular, to manufacture and distribute only such things as are of use and beauty, serviceable to the truest need of mankind; that these products should be produced and distributed with the greatest efficiency, avoiding waste of both labor and materials; that the returns from business should be based upon the serviceability of the product and the efficiency of its manufacture, rather than accrued from sharp practices of any kind. He further referred to the relations between the management and the employes of manufacturing establishments, pointing out how equitable and harmonious relations may be established and how management should endeavor to organize and control business so that there may be, as far as possible, a smoothing out of the violent fluctuations of the business cycle, and to protect the workers in the industry from the hardships that are incident to these fluctuations.

The Highest Reward of Successful Management

Mr. Flanders sounded an important note when he said, "In our personal habits we will avoid extravagance and display, not only as personally unworthy but as socially dangerous. We will find our personal satisfactions in rational and fitting ways, and *particularly in the successful management of a socially useful business.* By precept and by example we will train the coming generation to these views of our duties and privileges with the hope that they may make continued progress toward a state where all who play the game of life may be rewarded with its highest satisfactions. Such aims as these may be held modestly and without pious cant. They involve no real self-denial or sacrifice on the part of the business man; they are simply a recognition of the durable satisfactions of life as distinguished from the shallow and transient ones.

"Particularly are these aims essential to our political stability. If the deepest current of American industry sets in this direction, we will not fear what government may do to us. So long as there is injustice, abuse of privilege, and cynical self-seeking in American business, so long will the politicians have it in their power to bring disaster to the business structure and distress to all the unfortunates, great and small, whose bread depends upon it.

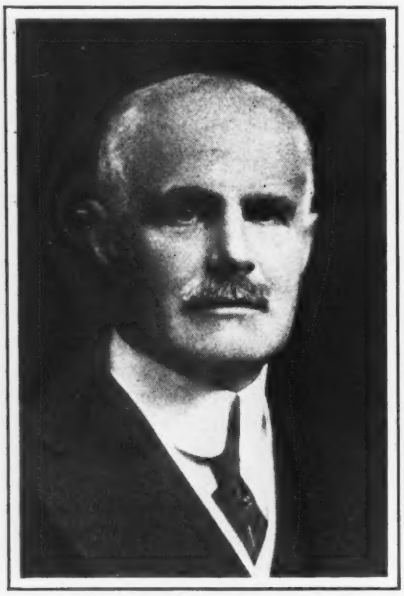
"If on the other hand, we manfully mold and control that structure, it will dominate political activities by virtue of its effectiveness and service. Then, and only then, will the professional politician play the minor part to which nature

assigned him, and government become the servant instead of the master of our lives."

The General Manager's Report

In his report, Ernest F. DuBrul, general manager of the association, first reviewed present business conditions, stating that since June there has been some slight improvement each month, and the industry has now entered on an upward swing that indicates increased business for some months to come. It would seem that business in 1925 ought to be equally good or better than in 1923. The second-hand market is not able to offer as many good machine tools at this time as it was in 1922, foreign conditions are much improved, the railroads are handling more freight, and credit is cheap and plentiful. The greater part of the new demand will be for replacements, but the replacements will be for the machines that are most up-to-date in design.

Mr. DuBrul then reviewed the activities of the association during the last four years, pointing out the important work that has been done in establishing rational cost-finding methods in the industry, and the formulation of a plan of accounting that discloses the true costs of producing machine tools. There is still much to do along these lines, however, and most of the concerns engaged in machine tool building are not yet making a reasonable allowance for the cost of necessary periods of enforced idleness in the industry. The association, through its general office, has also made a careful analysis of business conditions which shows quite clearly the great fluctuations in machine tool demand.



Frank N. MacLeod, First Vice-president of the National Machine Tool Builders' Association

Publicity as an Aid in Creating a Better Understanding of the Problems of the Industry

Before 1921 the difficulties of operating machine tool shops had received no particular publicity, but since that time the publication of various economic studies prepared by the association have called attention to the problems encountered, and numerous articles referring to the position of the machine tool industry have appeared in the engineering trade journals. Papers have also been read before numerous national societies on this subject. This publicity work is of value in many directions. It informs those who may have planned to enter the machine tool industry about the true state of affairs, and it also furnishes information to the buyers of machine tools in regard to the conditions under which this industry, by necessity, must operate. The spreading of this information will lead to a healthier situation in the entire field.

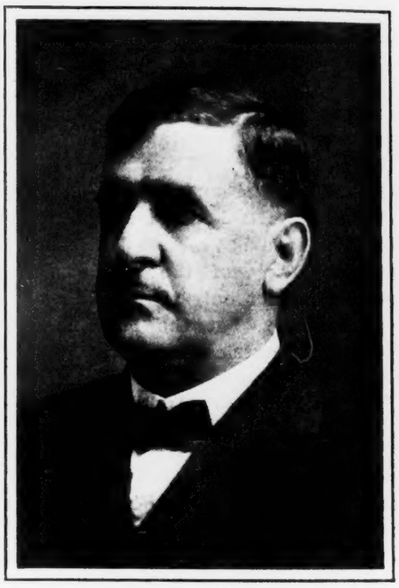
Numerous conferences have been held in addition to the regular conventions of the association. At these conferences important questions relating to the industry have been taken up. It has been shown that the excessive capacity of the industry was a liability and not an asset, and that this capacity would have to be utilized in one of several ways.

1. By creating new designs that would make old types of machines obsolete.
2. By making other products outside of the machine tool field.
3. By mergers, to concentrate production in fewer shops, selling the other shops for other uses.

A concern unable to adopt any one of these three methods of relief would, under the existing conditions of over-capacity and keen competition, be placed in an exceedingly difficult position; it was pointed out at the regional meetings that bankruptcy was almost sure to result, and that it would be only justice to the creditors and stockholders to liquidate before bankruptcy.

Among other important matters taken up by the association were information in regard to tax questions and efforts toward standardization. In 1922 the association began work on tool-holding and work-holding elements; and the standardization of toolposts, tapers, spindle noses, turret holes, T-slots, turret tool shanks and motor dimensions is now in the initial stages. A standard form for presenting the user of machine tools with the essential data required by him for installing and tooling up his machines has been adopted. This form is now used by a number of the members.

An address on the subject of "Ethics in Business" was presented by Frank C. Page, manager of the Resolutions and Referenda Department, Chamber of Commerce of the United States. In this address, reference was made to the fifteen principles of business conduct that have been adopted by the Chamber of Commerce of the United States, and that will be submitted as a basis for a code of ethics of the National Machine Tool Builders' Association. These principles are given in the following:



J. G. Benedict, Second Vice-president of the National Machine Tool Builders' Association

1. The foundation of business is confidence, which springs from integrity, fair dealing, efficient service, and mutual benefit.
2. The reward of business for service rendered is a fair profit plus a safe reserve, commensurate with risks involved and foresight exercised.
3. Equitable consideration is due in business alike to capital, management, employes, and the public.
4. Knowledge—thorough and specific—and unceasing study of the facts and forces affecting a business enterprise are essential to a lasting individual success and to efficient service to the public.
5. Permanency and continuity of service are basic aims of business, that knowledge gained may be fully utilized, confidence established, and efficiency increased.
6. Obligations to itself and society prompt business unceasingly to strive toward continuity of operation, bettering conditions of employment, and increasing the efficiency and opportunities of individual employes.
7. Contracts and undertakings, written or oral, are to be performed in letter and in spirit. Changed conditions do not justify their cancellation without mutual consent.
8. Representation of goods and services should be truthfully made and scrupulously fulfilled.
9. Waste in any form—of capital, labor, services, materials, or natural resources—is intolerable and constant effort will be made toward its elimination.
10. Excesses of every nature—inflation of credit, over-expansion, over-buying, over-stimulation of sales—which

create artificial conditions and produce crises and depressions are condemned.

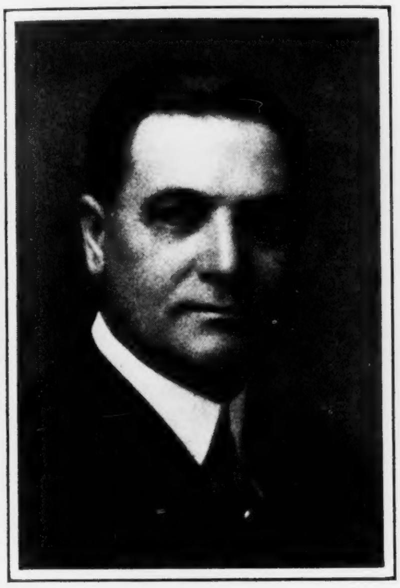
11. Unfair competition, embracing all acts characterized by bad faith, deception, fraud, or oppression, including commercial bribery, is wasteful, despicable, and a public wrong. Business will rely for its success on the excellence of its own service.

12. Controversies will, where possible, be adjusted by voluntary agreement or impartial arbitration.

13. Corporate forms do not absolve from or alter the moral obligations of individuals. Responsibilities will be as courageously and conscientiously discharged by those acting in representative capacities as when acting for themselves.

14. Lawful cooperation among business men and in useful business organizations in support of these principles of business conduct is commended.

15. Business should make restrictive legislation unnecessary by conducting itself so as to inspire public confidence.



H. M. Lucas, Treasurer of the National Machine Tool Builders' Association

An address entitled "How Can the Machine Tool Industry Help Itself?" by L. M. Waite, pointed out the necessity for constantly bringing out improved designs to meet the needs of the machine tool using industries. Mr. Waite outlined the general directions along which new developments should be made and pointed out that appearance as well as utility is as important a point in machine tool sales as in the sales in any other manufactured products.

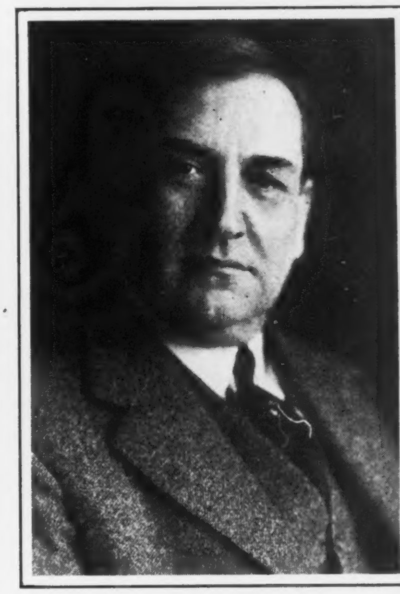
One session of the convention was devoted entirely to financial questions. At this session Robert N. Miller, of Miller & Chevalier, Tax Consultants, Washington, D. C., made an address on "Claims for Special Relief under Tax Laws," in which he imparted a great deal of valuable information in regard to the possibility for obtaining just and equitable relief under the present tax laws. L. H. Olson vice-president of the American Appraisal Co., New York City, addressed the association on "What is Your Plant Worth?" In this address he outlined the different methods used in appraisal work and pointed out the necessity for accurate appraisals for different purposes.

W. H. Rastall, chief of the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C., spoke on the machine tool situation in Europe. Mr. Rastall has just returned from a four months' trip to Europe where he visited England, France, Belgium, Holland, Germany, Poland, Czecho-Slovakia, Austria, Italy, and Spain. An abstract of Mr. Rastall's address will be published in December MACHINERY.

An address entitled "No Safe Short-cut to High Production" was presented by Professor Henry H. Farquhar of Boston, Mass., an abstract of which will appear in December MACHINERY.

Reports on Advertising, Expositions, Motor Dimensions, and T-slots

Among the committee reports presented at the meeting may be mentioned those on advertising, expositions, standardization of catalogue sizes, classification of second-hand tools, obsolescence of drawings, jigs, and patterns, standardization of motor dimensions, and standardization of T-slots. The committee on advertising dealt specifically with industrial advertising, advising that more of this type of advertising be done. The committee on expositions pointed out that the machine tool builders were asked to exhibit at too many exhibits, and favored the selection of a limited number of those which could be expected to give the best results. The committee on catalogue sizes presented definite recommendations in regard to the sizes of catalogues to be used in the machine tool industry. The committee on the classification of second-hand tools reported that it had been found impracticable to determine upon any kind of classification that would meet, in a satisfactory manner, the requirements of different manufacturers and of different types of tools. The committee on the obsolescence of drawings, jigs, and patterns presented a report that limited the number of years that manufacturers would keep jigs and patterns of discontinued models of machines.



Ernest F. DuBrul, General Manager of the National Machine Tool Builders' Association

In connection with the standardization of motor dimensions, L. F. Adams, electrical engineer of the General Electric Co., Schenectady, N. Y., pointed out the great difficulties facing the motor manufacturers if they were to standardize electric motors for machine tools so that there would be interchangeability between motors of the same capacity, built by different motor manufacturers, and also between direct- and alternating-current motors.

A progress report on the standardization of T-slots was presented, together with a questionnaire asking the opinions of the members of the association on the proposed standards worked out by the committee. A more complete abstract of this report will be found on page 192.

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ADVERTISERS' CONVENTION

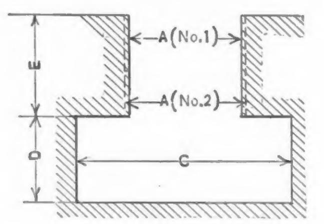
The National Industrial Advertisers' Association held its annual convention in Chicago October 13 and 14. Advertising and sales executives from all parts of the country were present and discussed ways and means of reducing the cost of selling to industry. Secretary Hoover of the Department of Commerce had prepared a paper on "Elimination of Waste in Distribution," which was read at the first session of the meeting. In the course of this paper Mr. Hoover stated that "an investigation into the problems confronting industry today develops the fact that through pressure brought about during the war and the boom period following, industrial organizations had built up their plants and technical departments to a high degree of efficiency. When depression came, the pressure of competition forced these same organizations to reduce production costs, but the distributive agencies seem to have been neglected. As a result, we have today too wide a spread between the cost of an article at the producing point and the cost to the consumer. This is unquestionably due to inefficiency and waste in selling, and our big problem today, therefore, is elimination of waste in distribution."

STANDARDIZATION OF T-SLOTS

A progress report, prepared by S. J. Teller, chief engineer of the Pratt & Whitney Co., Hartford, Conn., has been issued by the committee on the standardization of T-slots, working under the auspices of the American Society of Mechanical Engineers and the National Machine Tool Builders' Association. A brief review of the committee's report follows: A nomenclature for the various T-slot dimensions has been proposed, as indicated by the accompanying illustration and table. A general review of the T-slots now in use has led the members of the committee to believe that this standardization project should provide T-slots for bolts of the following diameters: 1/4, 5/16, 3/8, 7/16, 1/2, 5/8, 3/4, 7/8, 1, 1 1/4 and 1 1/2 inches. A few other sizes are in use, but it seems that they should be eliminated.

A study of the T-slots now in use by various manufacturers shows wide variations in all of the dimensions. However, the T-slot milling cutters offered to the trade by the majority, if not in fact all, of the cutter manufacturers, conform to a common standard. It has therefore seemed to the members of the committee that these T-slot cutter dimensions should serve as a basis for standardizing the widths and depths of the head spaces. An analysis of the existing T-slots shows that approximately one-half of them have the widths of the head spaces corresponding to standard cutters, and about one-third of them have the depths of the head spaces corresponding to standard cutters. While this shows that the use of standard cutters is far from universal, it is nevertheless to be noted that only in a few cases are the variations from these standards great enough to necessitate changes in castings. For instance, for the 5/8-inch slots the standard head space width is 1 3/16 inches; the smallest is 1 inch and the largest is 1 1/4 inches; similarly, for the head space depth the standard is 13/32 inch; the smallest is 1/4 inch, and the largest is 17/32 inch.

PROPOSED STANDARDS FOR T-SLOTS



Width of Throat A		Width of Head Space C	Depth of Head Space D	Depth of Throat E
No. 1	No. 2			
1/4	9/32	1/2	5/32	Not yet recommended by the committee
5/16	11/32	5/8	5/32	
3/8	7/16	11/16	7/32	
7/16	1/2	13/16	7/32	
1/2	9/16	15/16	9/32	
5/8	11/16	1 3/16	13/32	
3/4	13/16	1 5/16	17/32	
7/8	15/16	1 5/8	11/16	
1	1 1/16	1 7/8	13/16	
1 1/4*	1 5/16	2 1/4	1	
1 1/2*	1 9/16	2 3/4	1 1/4	

*No standard cutters for these sizes.

The most important variation in practice among the various machine tool builders is in the width of the throat. This is obviously the most important dimension, as it is the only one that greatly affects the interchangeability of attachments and fixtures. A considerable number of manufacturers provide T-slots of the same width as the nominal diameter of the bolt, the bolt itself being slightly under size. A large number of other manufacturers provide T-slots wider (usually by 1/16 inch) than the nominal diameter of the bolt. This latter practice facilitates the use of T-nuts instead of the conventional T-bolts.

There is no need of reviewing the arguments concerning the relative merits of the two practices. It is sufficient to point out that each of them is so thoroughly established as to greatly add to the difficulties of standardization. If either practice is decided upon as standard, much expense and confusion will be involved in bringing a large number of widely used machines into accord with the new standard.

As the result of the foregoing difference in practice the committee has under consideration three proposals:

1. Throat width same as the nominal diameter of the bolt (No. 1 in table).
2. Throat width 1/32 inch and 1/16 inch greater than the nominal diameter of the bolt (No. 2 in table).
3. Throat width optional, leaving the manufacturer a choice between the two preceding proposals, according to his preference or his past practice.

In connection with the third proposal it has been suggested that attachments and fixtures be provided with reversible keys or tongues so that they can fit T-slots of either dimension.

The accompanying table shows the actual sizes of the T-slots under discussion. The head space dimensions are in accordance with standard T-slot cutters, except in the case of the two larger sizes for which no standard cutters are listed; and two dimensions are given in each case for the width of the throat, corresponding approximately to the two differing practices already referred to. It should be noted that the throat widths given correspond exactly to the British standard already established. According to the British standard the throat width is optional, either dimension being permissible. The committee is not yet ready to make any recommendation concerning the depth of the throat.

The committee is indebted to L. D. Burlingame, industrial superintendent of the Brown & Sharpe Mfg. Co., Providence, R. I., not only for a large part of the preliminary work that has been done, but also for a series of tests of the strength of T-slots as cut by standard T-slot cutters. No attempt will be made here to include a complete report of these tests, but they have shown that, with a suitable depth of throat, it is the bolt that fails and not the T-slot. In nearly every case the bolt broke at the root of the thread, there being no noticeable deformation of the bolt head and no crushing of the surface of the T-slot. There was no noticeable difference in strength, between a slot approximately fitting the bolt and a slot 1/16 inch wider. It will be understood that this is merely a report of the progress of the committee and does not constitute the final recommendations.

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AUTOMOTIVE ENGINEERS' MEETING

The annual production meeting of the Society of Automotive Engineers was held October 22 to 24 in the General Motors Building, Detroit, Mich. Among the papers presented were: "Reducing Manufacturing Costs," by A. L. DeLeeuw, Consulting Engineer, New York City; "Coining-Press Operations on Automobile Parts," by A. R. Kelso, Hudson Motor Car Co.; "Experience with the Group-Bonus Plan," by H. G. Perkins, Maxwell Motor Corporation; "Reducing Labor Turnover," by C. A. Lippincott, Studebaker Corporation of America; "Methods of Shipping Motor Cars," by Ben Moore, Dodge Bros., and Frank Henry, Studebaker Corporation of America; "Utilization and Prevention of Waste," by Carl B. Auel, Westinghouse Electric & Mfg. Co.; "Salvage of Tools," by L. A. Churgay, Maxwell Motor Corporation; "Reducing Wood Waste in Body Manufacture," by B. Naaglevoort, Towson Body Co.; "Some Notes on Tool Design," by Joseph Lannen, Paige-Detroit Motor Car Co.; "Avoiding Mistakes in Tool Design," by Paul V. Miller, Taft-Peirce Mfg. Co.; "Improvements in Nickel Plating," by W. H. Graves, Packard Motor Car Co.; "Durability of Plated Surfaces," by W. M. Phillips, General Motors Corporation; "Supervision of Factory Maintenance; Reducing its Cost," by E. E. Remington, Ford Motor Co., L. A. Blackburn, Olds Motor Works, and Fred Sharp, Oakland Motor Car Co.

American Gear Manufacturers' Convention

THE fall meeting of the American Gear Manufacturers' Association held at Briarcliff, N. Y., October 16 to 18, was marked by the same thorough attention to standardization subjects as the previous meetings. At the opening session, the president of the association, George L. Markland, Jr., of the Philadelphia Gear Works, Philadelphia, Pa., emphasized the importance of the standardization work that the association has undertaken. He particularly laid stress on the fact that the manufacturers of gears should, themselves, do whatever standardization work is required in connection with gears and gearing problems. They are better able to do this, because of their experience, he stated, than outside engineering societies who are not as completely informed about all the problems met with in the gear industry. He pointed out that the slogan of the association, "A gear standard to be a recognized standard should be an A. G. M. A. standard," must become the vital principle of the association work, and he urged all members to continue steadily with the standardization of all classes of gearing, as it is certain that if the association does not do its duty in this respect, other engineering societies will step in and do it, possibly to the detriment of the gear industry.

In his report to the association, the secretary, T. W. Owen, whose headquarters are at the association's office, 2443 Prospect Ave., Cleveland, Ohio, reviewed completely the work of the association during the past year. The membership committee reported the following new member companies: Cleveland Worm & Gear Co., Cleveland, Ohio; Dodge Mfg. Corporation, Mishawaka, Ind.; and Farrel Foundry & Machine Co., Buffalo, N. Y.

General Standardization Work

In the report of the general standardization committee, submitted by the chairman, B. F. Waterman of the Brown & Sharpe Mfg. Co., Providence, R. I., it was pointed out that while a great deal of work had already been done by the standardization committees of the association, there was still far more to do. Mr. Waterman summarized briefly the important things that had been done in standardization work during the past year by the association, as follows: A number of additional pages for the A. G. M. A. handbook have been printed; a recommended practice for steel castings, a revised recommendation to replace the one dated October 14, 1921, has been adopted; a suggested standard for future design of spiral bevel gears, bound in cloth, has been distributed by the Gleason Works, Rochester, N. Y.—an important contribution to the literature of gear design; a recommended practice for the tooth proportions of stub-tooth and standard full-depth-tooth gears, has been adopted.

In addition, very generous support has been given to the gear research committee of the American Society of Mechanical Engineers by members of the American Gear Manufacturer's Association. The work on gear research, it is expected, will increase the knowledge of the strength of gears and will make it possible to design safer and quieter gears. The testing machine which is to be used by the research committee is being built by the Bilgram Machine Works, Philadelphia, Pa., and is now nearing completion. When ready, it will be shipped to the Massachusetts Institute of Technology, where the tests on the strength and other properties of gear teeth will be conducted.

Progress reports were also submitted by practically all of the standardization committees of the association, covering standardization work on spur gears; transmissions; differentials; bevel and spiral bevel gears; nomenclature; tooth forms; gears and pinions for electric railway, mill, and mine use; herringbone gears; sprockets; worms and worm-gears; non-metallic gearing; keyways; inspection; metallurgy; and industrial relations.

Papers read before the Convention

Papers were read before the meeting by T. C. Roantree of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., on "New Gear Applications"; by Thomas J. Haley of the Fawcus Machine Co., Pittsburg, Pa., on "Shop Costs"; by Warren G. Jones of the Jones Foundry & Machine Co., Chicago, Ill., on "Spur Gear Speed Reducers"; by W. A. McCarrell on "The Trend of the Transmission"; and by Erik Oberg, editor of MACHINERY, on "How are Our Future Mechanics to be Trained?" An address relating to what produces business and how it can be best stimulated was made by Arthur J. Baldwin, vice-president of the McGraw-Hill Co., New York City.

New Gear Applications

In his paper on new gear applications, Mr. Roantree pointed out the importance of gear manufacturers devoting some attention to new applications for gearing, in order to increase the use of gearing in places where it might prove of greater advantage than other means for transmitting motion. In the past, gears have come into use in mechanisms principally because they have been suggested by the designer or the manufacturer of the mechanism. The gear manufacturers have merely filled the orders that have come to them, without giving serious attention to whether gears could be more advantageously used in many products now using other power transmitting means. Possibly, by an increased use of gears, many mechanisms could be so designed and assembled that their functioning would be greatly improved.

It is urged, therefore, that gear manufacturers give the designers of mechanisms more assistance in developing means for transmitting motion or power. In many cases the inventor or designer of any particular product is a specialist on that particular type of mechanism, and may not be able to take full advantage of correct gear applications. By taking an interest in the application to which gears are put, gear manufacturers doubtless could materially assist in increasing the use of gears, because of the greater efficiency with which they might be used, if properly applied.

Publicity to Point out Recent Improvements in Gearing

The speaker pointed out that while there is no doubt that a better grade of gears is produced today than only a few years ago, both because of better materials, better means of cutting the teeth, and better heat-treatment, as well as more careful inspection and testing, yet the general engineering field has not been made as conversant with this fact as would be desirable, and the value of publicity cannot be over-emphasized. The superiority of cut gears to cast or punched gears was stressed by Mr. Roantree, and he advocated publicity to impress this fact thoroughly upon the users of gears. He also advised gear manufacturers to use the columns of technical publications for spreading correct information regarding mounting, inspecting, repairing, and lubricating gearing.

Comparison Between Gear and Chain Drives

The speaker also pointed out that the appearance on the market of non-metallic gear materials and the growing use of the chain drive indicated that in some instances the manufacturer of metal gears had not fully taken advantage of his opportunities. There are many instances where chain

or belt drive is now used simply because the manufacturer furnishing the gears for that particular application could not attain a quality that would result in the desired degree of quietness when the gears were meshing. While it is admitted that there are several applications in which the nonmetallic material or the chain drive can better serve the purpose than a metal gear, still it is true that the inaccuracies permitted to enter into gear transmissions are responsible for much of the adverse criticism of gears as compared with chain drives.

The question of noise is one to which the gear manufacturer must give serious attention. The essential conditions for a quiet-running gear train, as is well known, are correct tooth contour, proper alignment, and careful assembly. Generally, the two latter conditions are fairly well taken care of by the manufacturer of the product in which the gears are used, but the first depends entirely upon the gear manufacturer, and unless all three are carefully considered, it will be impossible to obtain quiet-running gears.

Standardization as an Aid in Obtaining More Business

The work of standardization is of value from many points of view, but there is a commercial side that should not be overlooked: The feature that particularly appeals to the customer is the possibility of readily obtaining a duplicate for replacement, should this be needed, and thus repairs can be taken care of with a minimum amount of delay and expense.

Among new opportunities for increased applications of gears may be mentioned gears for direct motor drives, which save the expense of overhead transmissions and reduce the floor space required. In the agricultural machinery industry, there are many additional uses for gears if the builders of this class of machinery could be shown their advantages. For more quiet operation, the gear manufacturer should advocate the use of helical gearing, when end thrust is permissible, and he should recommend the use of hardened and ground gears for such applications as require this refinement. Furthermore, the gear manufacturer should suggest the use of worm-gears as a substitute for bevel gears in right-angled drives, when he is convinced that these would provide for greater efficiency. By cooperating with the designer of machinery for any industrial application, the gear manufacturer can create a greater market for gears by helping to make them successful in every mechanism in which they are used.

A Simple Shop Cost System

The paper on shop costs by Thomas J. Haley briefly summarized the cost methods used by the Fawcus Machine Co. The cost accountant's position, the speaker pointed out, is primarily one of recording and compiling facts, but he generally has no control over the factors determining the costs, nor of the use to which the data thus compiled is put. It is the operating executive who is in a position of direct control, and it is upon him that it involves to make such use of the data as will improve the efficiency of the plant operation.

In smaller plants the executive is not very far removed from the operating side of the business; as a result there is a likelihood of neglecting a careful study of costs, since the executive feels that he is in close touch with all conditions and knows them to be correct. While it is admitted that no system of records will supplant human sagacity on the part of a successful industrial executive, it is also true that the history of industrial plants records many failures that might have been avoided had data been compiled and used as a guide in the conduct of the business.

The company with which the author of the paper is connected uses a comparatively simple method for recording costs. Labor is charged directly to the jobs in production. The shop overhead cost, which is under the direct control of the operating executive at the time of incurring the expense, is pro-rated over the jobs on the basis of predetermined rated machine hours.

The rated machine hours are determined by a survey of the entire plant and equipment. The ratings are established by determining the cost of operating the machine full time. This cost includes depreciation on buildings and equipment, insurance and rent, all apportioned by square feet of floor space occupied. It also includes power cost apportioned by rated horsepower, as well as small tool expense at cost.

Costs other than shop costs are under the direct control of the managing executive, and are pro-rated over the operations on the basis of productive hours. The total cost thus obtained is recorded monthly on the job unit basis, and is referred to the various departments for examination and guidance in future activities. The method outlined in the foregoing has proved highly satisfactory over a period of six years.

How Are Our Future Mechanics to be Trained?

In his paper on the training of men for the machine shop industries, Mr. Oberg stated that, generally speaking, there are four distinct methods by which the future workers of the industries may be trained. They are:

First, the regular apprenticeship, amplified to meet present-day conditions. For practically every large plant the regular apprenticeship system is one of the best methods. When no one shop in a locality is large enough to maintain apprenticeship courses on a modern basis, a type of cooperative apprenticeship system has been inaugurated in some cases; the boys work regularly in the respective shops where they are apprenticed, but attend a school maintained by the manufacturers on a cooperative basis two afternoons a week.

Second, the vocational or trade school, generally maintained by a city or municipality. Some cities are large enough to engage successfully in vocational education as part of the public school system.

Third, the cooperative high school, where a boy acquires a general education especially suited for the life work in which he expects to engage, and at the same time actual shop experience in productive work in manufacturing establishments. Under this plant the boys work alternately two weeks in the shops and two weeks in school.

Fourth, the method variously known as the vestibule school, the shop training department, or the special apprenticeship, which is not intended to train all-around mechanics, but simply workers who will be proficient in the operation of some one line of machine tools.

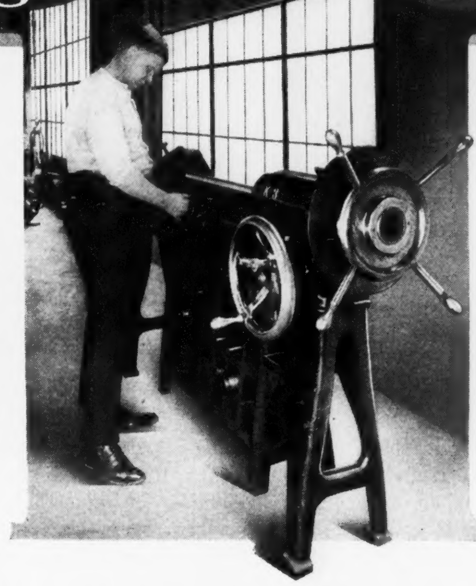
Each one of these methods was taken in order and briefly reviewed. The success that has been attained where these methods have been properly and conscientiously applied was explained in detail. The speaker mentioned that it is frequently said to be impossible at present to maintain a regular apprenticeship system, but showed that there are a sufficient number of shops successfully maintaining these systems to prove that it can be done if done in the right way.

* * *

MEETING OF WELDING SOCIETY

The American Welding Society held its fall meeting at Hotel Winton, Cleveland, Ohio, October 30 and 31. The technical sessions were held Friday morning, and a number of papers were read on the application of welding in the construction of bridges and buildings. In order to bring about a more general use of welding in structural work, a great deal of additional information is required and costly investigations will be needed. Engineers, designers, and draftsmen must be furnished with accurate data as to costs, the methods to be used, the strength to be expected, the types of joints recommended, factors of safety, and similar engineering data. Furthermore, it will be necessary to convince the law makers in the respective states that welding is safe and adequate for the purpose intended. It was with a view to bringing to the attention of the members the importance of this work and its possibilities that an entire technical session was devoted to it.

Checking Lathes for Accuracy



Methods Employed at the Plant of the American Tool Works Co., Cincinnati, Ohio, in Inspecting Various Parts of the Lathes and the Assembled Machines

THE accuracy of work turned in a lathe depends on the accuracy of the lathe itself. This accuracy can be insured only by careful inspection when the lathe is built. Thousands of toolmakers and machinists who make daily use of the most generally employed of all machine tools will doubtless be interested in the kind of inspection to which a lathe is subjected by its builders in order to insure that it will be able to turn out work to the degree of accuracy guaranteed. In the present article the methods used in the plant of the American Tool Works Co., Cincinnati, Ohio, for inspecting the various parts of the lathes and the assembled machines will be described in detail.

Testing Beds for Straightness and Parallelism

The first requirement for producing work accurately in a lathe is a straight bed. When the bed has been finish-planed to a templet, it is tested to determine whether it is level throughout its entire length, either while it is still on the planer, but unclamped, or while supported on special horses. In this test, the bed is shimmed only at the ends, as shown at *A*, Fig. 1. Three or four special blocks *B* which have grooves on the bottom to mate the vees on the bed, and which are flat on top, are then placed a certain distance apart on the bed. A piece of tissue paper is next laid on each block and a 6-foot straightedge *C* laid across the blocks as shown. With the straightedge in this position, if the bed is level, it will be impossible to pull the pieces of tissue paper out without tearing them. If it is found that the papers can be withdrawn, this is an indication that the bed must be replaned.

To test the side alignment of the bed, the straightedge is similarly applied against the ends of blocks *B*. A templet similar to these blocks but about twice as wide is also moved along the bed to insure that carriages can be applied interchangeably. Fixture *D* is used to determine whether the top and front side of the bed at the headstock end have been planed accurately for receiving the gear-box. This fixture also seats on the bed vees, and is provided with a vertical pin *E* and a horizontal pin *F* which have collars that must touch finished bosses on the fixture when the ends of the pins are brought in contact with their respective surfaces on the bed.

Inspection of Lead-screws

The most difficult part to produce is the lead-screw, which is limited to an error of 0.001 inch per foot. The heading illustration shows a machine that has been built especially for inspecting this part. The lead-screw is inserted through the headstock, and the right-hand end gripped in the collet jaws of a chuck. These jaws are opened and closed by revolving the capstan handles. The opposite or threaded end of the lead-screw is gripped in the half-nuts of tailstock *A*, as may be seen by referring to Fig. 2. The tailstock may be freely slid by hand on an inclined dovetail surface of the machine that has been highly finished by scraping. Top block *B* of the tailstock and the upper half-nut are not put in place until after the lead-screw has been inserted through the tailstock.

In making a test on this machine, a Johansson gage-block *C* is laid on true hardened surfaces of a small fixture mounted on carriage *D*, and the carriage is pushed toward the tailstock until it is just possible to insert a 6-inch end measuring rod *E* between the gage-block and the hardened end of a pin that projects slightly from the face of the tailstock. The small adjusting screw on the fixture mounted on carriage *D* permits just the right "feel" of the measuring rod to be obtained.

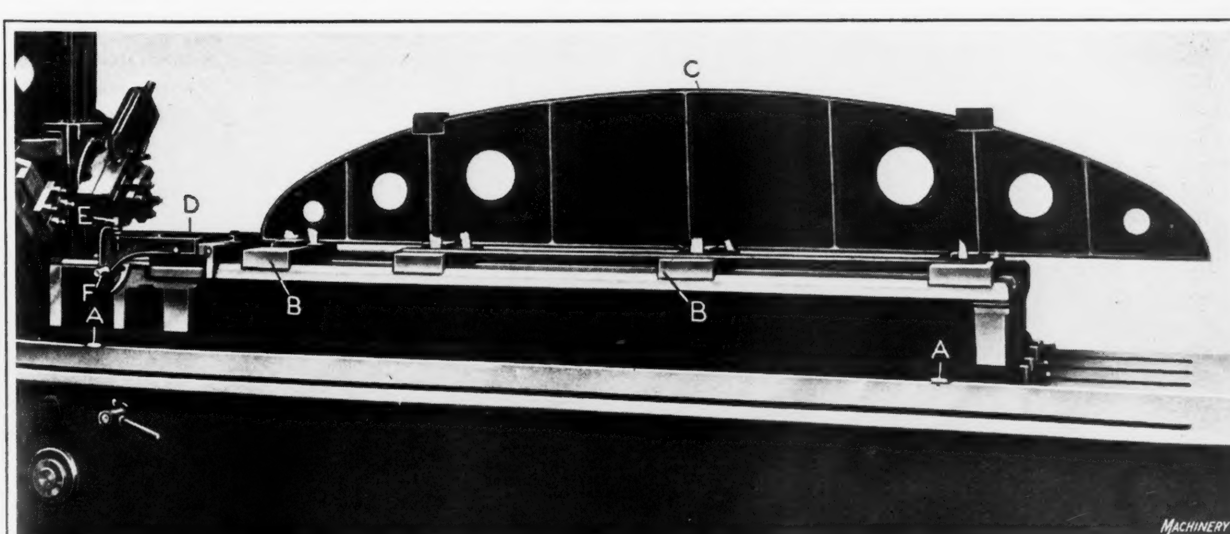


Fig. 1. Testing a Lathe Bed for Straightness by Means of Flat-top Blocks and a Six-foot Straightedge

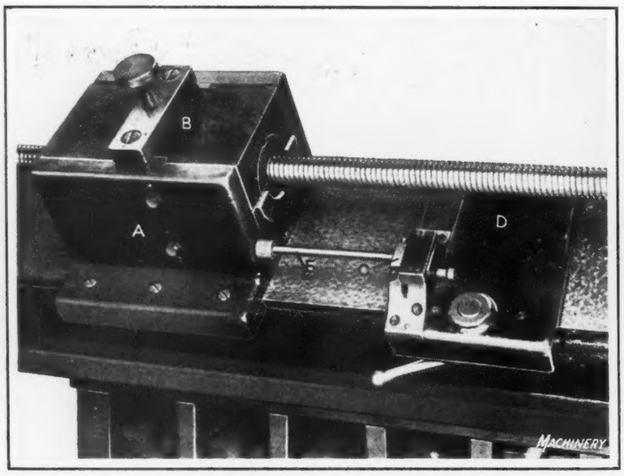


Fig. 2. Setting the Carriage of the Lead-screw Testing Machine Relative to the Tailstock before making a Test

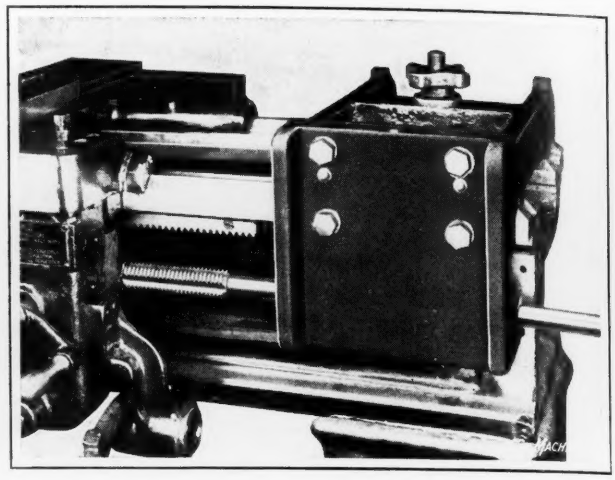


Fig. 3. Special Fixture used in finish-tapping the Apron Half-nuts in Proper Relation with the Bed Vees

The carriage is next clamped securely to the bed of the machine, and the handwheel seen at the front in the heading illustration is turned a certain number of revolutions, depending on the lead of the screw, so as to rotate the screw a sufficient number of times to advance the tailstock exactly 6 inches. The large disk in front of the capstan handles revolves with the screw, and it is graduated in degrees on the periphery, so that it is an easy matter to turn the lead-screw the exact number of revolutions desired. The graduations are spaced about 1½ inches apart on the disk and each of these divisions represents a distance of about only 0.0075 inch around the periphery of the work.

After the tailstock has been advanced 6 inches, it must be possible to just slip between the hardened pin on the tailstock and the surfaces of the fixture on carriage *D*, the same gage-block that was used in setting the carriage 6 inches distant from the tailstock. If the gage-block fits too tight or too loose, it is easy to determine the exact error by simply using wider or narrower gage-blocks. This test is conducted every 6 inches along the whole lead-screw, and as already mentioned, the error must not be more than plus or minus 0.001 inch per foot or 0.0005 inch per 6 inches. In a screw recently tested by this means, the maximum error of lead was 0.0004 inch in 3 feet, and in the instance illustrated there was no perceptible error in 2 feet. However, this test does not guarantee that there are not slight inaccuracies in the thread which do not show up in testing every 6 inches, and so an actual thread-cutting test, which will be described in detail later, is conducted after the screw has been assembled in the lathe.

Preliminary Checking of Headstock Spindle

A preliminary checking of the finished headstock spindle is made while it is still in the lathe fixture in which it is held while the spindle hole is taper-bored and reamed and the nose threaded. This inspection is shown in Fig. 4. Here it will be noticed that a test bar *A* has been inserted in the spindle and that an indicator, held in the toolpost, is applied on the overhanging end of the test bar as the spindle is rotated. The test bar projects 18 inches from the spindle nose, and as the allowable error in the rotation of the bar is only 0.001 inch, it will be evident that this test is a severe one. As a matter of fact, the error may be above center but never below. Spindles are usually held within 0.0005 inch to minimize the danger of inaccuracy when later assembled in the headstock. The indicator is also applied to the test bar close to the spindle nose to check the straightness of the test bar as held in the spindle.

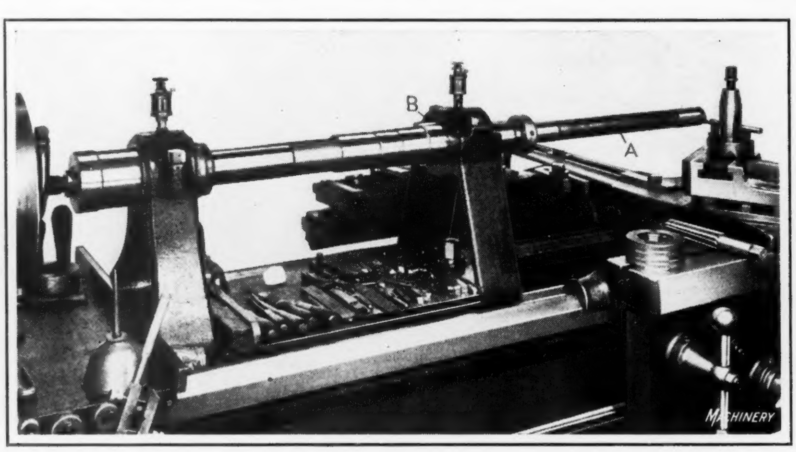


Fig. 4. Checking the Accuracy of the Headstock Spindle

Fixture *B* is used in this operation to make sure that the spindle will fit the headstock within the required limits. The distance between the fixture bearings, their height above the bed, and their diameter all agree to similar dimensions on the headstock, and the fixture fits on similar vees. It will be apparent that a different fixture is required for each spindle intended for a lathe of different swing or having other variations in the headstock. The hole in both the spindle and the spindle bushing are finished to gages while the part is mounted in this fixture, and the thread is chased on the nose to the ring gage seen on the carriage.

Inspection on the Erecting Floor

There is a complete system of inspection used throughout the plant to insure that the parts are accurate as they come from the machines, but the remainder of this article will deal principally with tests conducted on the erecting floor. Here headstocks, aprons, gear-boxes, compound rests, and tailstocks are completely assembled, geared headstocks having been previously tried out under belt to see that all parts fit and run properly without undue noise and that all members are lubricated thoroughly. Gear-boxes are given a similar test in the department in which that unit is assembled.

On the erecting floor, the first step is to see that the bed is set up level, as proved by means of accurate spirit levels applied transversely at both ends of the bed and at the center and longitudinally across the wings of the carriage. The bed is made level by driving wedges under the legs. Great care is taken in this set-up, because no matter how precisely a lathe may be built, it will not produce accurate work if the bed is not level.

An interesting operation in assembling the various units on the erecting floor is to align the half-nuts of the

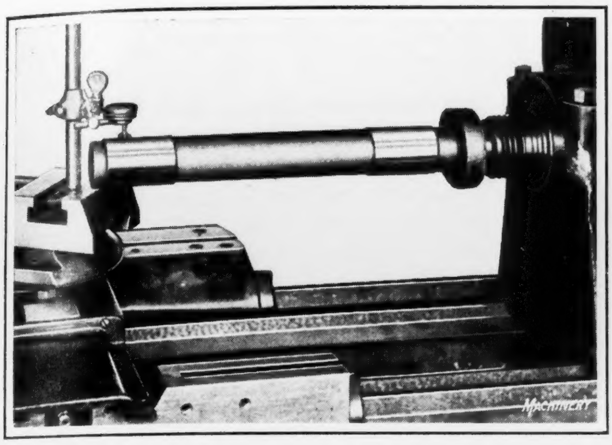


Fig. 5. Determining the Alignment of the Headstock Spindle when assembled on the Machine

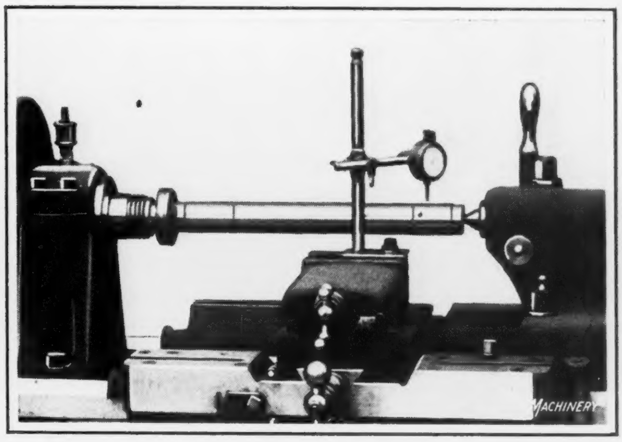


Fig. 6. Determining the Alignment of the Tailstock Spindle with that of the Headstock

apron in relation to the vees of the bed by taking a light finish-tapping cut. This operation is illustrated in Fig. 3. It will be seen that a fixture is clamped to the bed vees at the tailstock end, which has an arm extending down in front of the bed. In this arm there are bushings which serve to locate the tapping bar as required. The tap is rotated by hand. After the lead-screw has been assembled, a test is taken to insure that the screw is in line with the bed for the entire length. This test consists of placing across the vees of the bed a templet which has an arm that extends downward and holds an indicator for application to the lead-screw. The templet is twice moved from one end of the bed to the other with the indicator registering on the top and one side of the screw, respectively, and the error must not be over 0.002 inch. The bosses in the gear-box, against which thrust washers of the lead-screw register, are finished at right angles to the screw axis within close limits, and the thrust washers are required to be parallel within 0.00025 inch.

After running-in the headstock for several hours and trying out the various mechanisms of the machine, the alignment of the headstock spindle is checked with an overhanging bar, as shown in Fig. 5. Before inserting this bar in the spindle, the spindle bushing is carefully cleaned out, tested with a plug gage, and the bar thoroughly wiped. This bar also overhangs 18 inches, and has two finished surfaces about 2 1/4 inches in diameter. With the indicator touching the test bar as it rotates, the variation must not be greater than 0.001 inch at the outer end nor more than 0.00025 inch at the spindle nose.

The indicator is also run along the top and front side of the test bar ends while the bar is stationary to determine its straightness in the lathe. As in the preliminary test made immediately after the spindle nose was finished, any error in the rotation of the test bar must be above center and not below. If the variation in the readings is greater than permissible, the headstock is removed and again scraped along the V-grooves. A test is also made on the draw-in collet after it has been assembled; a bar projecting 4 inches must run true within 0.001 inch at the outer end.

The tailstock spindle is next aligned by advancing the tailstock until its center supports the projecting end of the test bar, and then applying the indicator as illustrated in Fig. 6. With this set-up, any misalignment of the tailstock spindle will be proved by a movement of the bar. The test is first taken with the spindle barrel flush with the tailstock casting and then with the tailstock spindle extended the full amount. The variation of the test bar rotation with the tailstock spindle in or out must not exceed 0.001 inch.

When a tailstock has been set as necessary to pass the requirements of this test, a line is scribed on the upper casting of the tailstock opposite the zero mark of the graduations provided on the base for setting the tailstock in turning tapered work. As in the case of the headstock spindle, the tailstock bushing and center taper are tried for fit prior to this test. If the fit is not satisfactory, red lead is applied to the center, and it is rotated in the bushing to determine where the inaccuracy exists. Then a light reaming cut is taken to correct the inaccuracy, by rotating the taper reamer with a tap wrench.

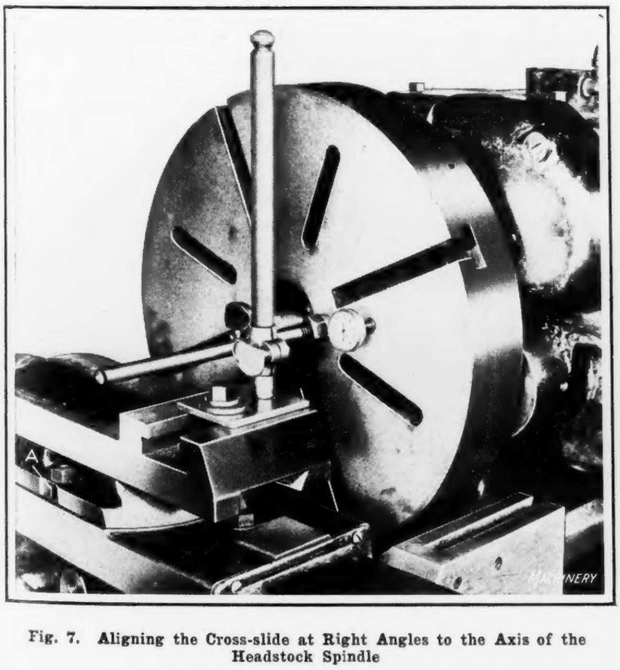


Fig. 7. Aligning the Cross-slide at Right Angles to the Axis of the Headstock Spindle

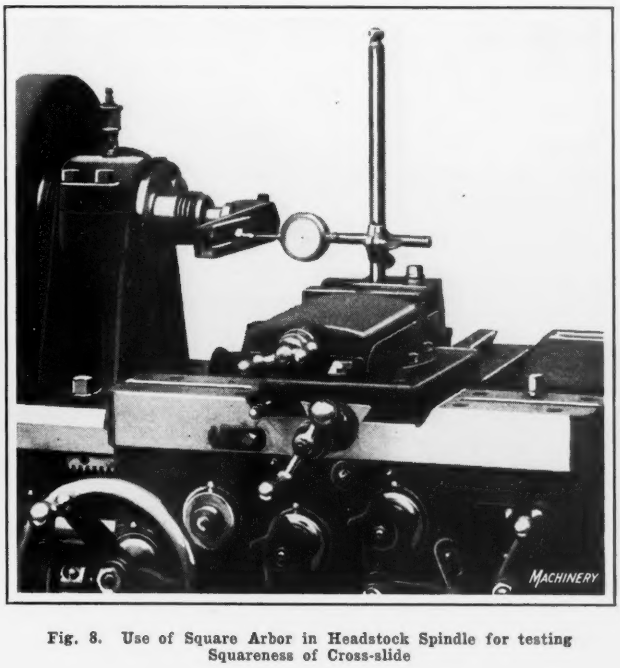


Fig. 8. Use of Square Arbor in Headstock Spindle for testing Squareness of Cross-slide

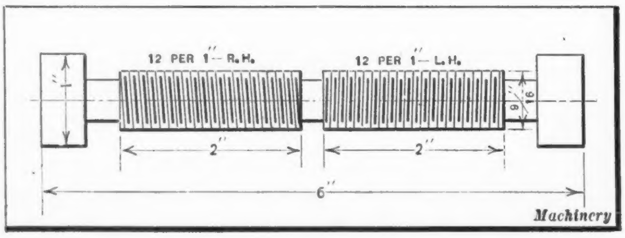


Fig. 9. Piece turned and threaded to check Accuracy of Lathe

Truing the Faceplate and Setting the Compound Rest

To insure that the front of the faceplate will be at right angles to the axis of the headstock spindle, the faceplate is finish-faced while mounted on the spindle, the cuts being taken with a tool mounted on the cross-slide. The faceplate may be perfectly straight or hollow at the center to the extent of 0.0005 inch, but it cannot be convex even the slightest amount, because such a condition would prevent the rigid clamping of work. The accuracy is determined by laying a precision straightedge across the faceplate with pieces of tissue paper under it and then attempting to pull out these papers. A small driving faceplate is next trued up in a similar manner.

Another important step is to align the cross-slide at right angles to the spindle. This is accomplished by mounting an indicator on the cross-slide, as shown in Fig. 7, and with the compound rest loose on the carriage, and the indicator contacting with the previously finished faceplate, feeding the cross-slide in and out and constantly adjusting the compound rest until the indicator registers zero within close limits across the entire faceplate. When the true right-angle position of the cross-slide has thus been determined, a line is scribed on the compound rest at *A* directly above the zero mark of the graduations on the carriage. An alternative method sometimes used is to hold a straightedge in contact with the finished front surface of the faceplate and then bring the adjacent finished side of the cross-slide into contact with the opposite side of the straightedge. Line *A* is then scribed on the compound rest.

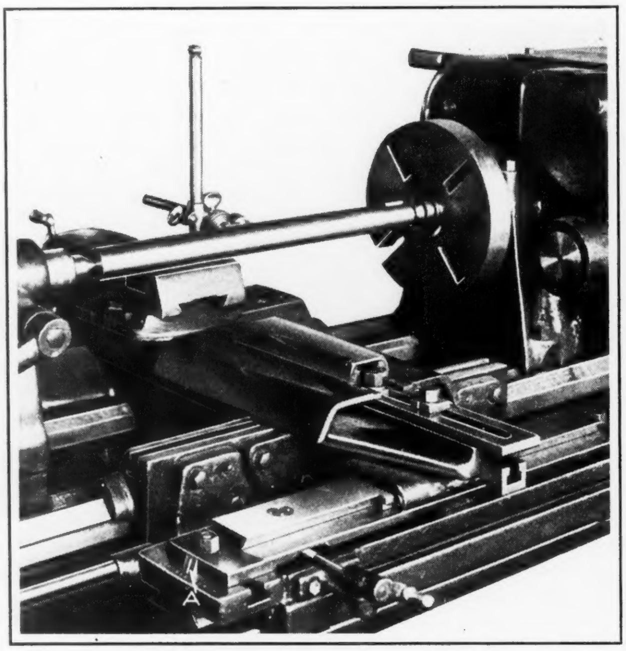


Fig. 10. Aligning the Taper Attachment

There is also a preliminary alignment of the cross-slide in assembling the head, carriage, tailstock, etc. This step is illustrated in Fig. 8. Inserted in the headstock spindle is a special tram or squaring arbor, which has an arm extending at right angles to the spindle on which there is a projecting hardened stud. While the arm is in a horizontal position in front of the spindle, a reading is taken with the indicator on the end of the stud, and then the tram is swung around 180 degrees to the rear of the spindle and the cross-slide advanced to bring the indicator again in contact with the stud. If the indicator varies more than the allowed amount, the carriage ways are rescraped until the cross-slide is shown to be square.

Testing the Lead-screw on the Lathe

After the carriage has been run back and forth a number of times to run in the lead-screw, a test is made to see that the lead-screw feeds the carriage at the desired rate within plus or minus 0.001 inch per foot. In making this test, a hardened stop-pin in block *A*, Fig. 11, which is clamped to the carriage, is brought in contact with the projecting anvil of micrometer *B* which is held in a clamp attached to a vee of the bed. After establishing this relation, the faceplate is revolved by hand the number of revolutions required to revolve the lead-screw a sufficient number of times to feed the carriage exactly 12 inches. Accurate rotation of the faceplate is assured by using a spring indicator *C* with reference to a chalk line mark on the periphery of the faceplate. After the carriage has been advanced as described, a 12-inch measuring rod *D* is passed between the micrometer anvil and the stop on block *A*. The error in length, as indicated by this measuring rod, must not be more than 0.001 inch, the exact amount being determined by advancing or withdrawing the micrometer anvil.

Following this step, the carriage is advanced another 12 inches without changing the setting of the micrometer clamp, and then a 24-inch measuring rod is used to check the advance. The micrometer clamp is next loosened and the micrometer moved against the stop of block *A* preparatory to taking the next measurement. In this way the lead-screw is checked for each foot of length.

Even though a lead-screw should appear satisfactory according to the foregoing test, there might be errors that do not show up because some errors might compensate for others. To guard against this, threads are chased on a specimen, and each of these threads is carefully examined with a micrometer to insure that the lead is constant. A drawing of one of these specimens is shown in Fig. 9. It will be noted that both right- and left-hand threads are

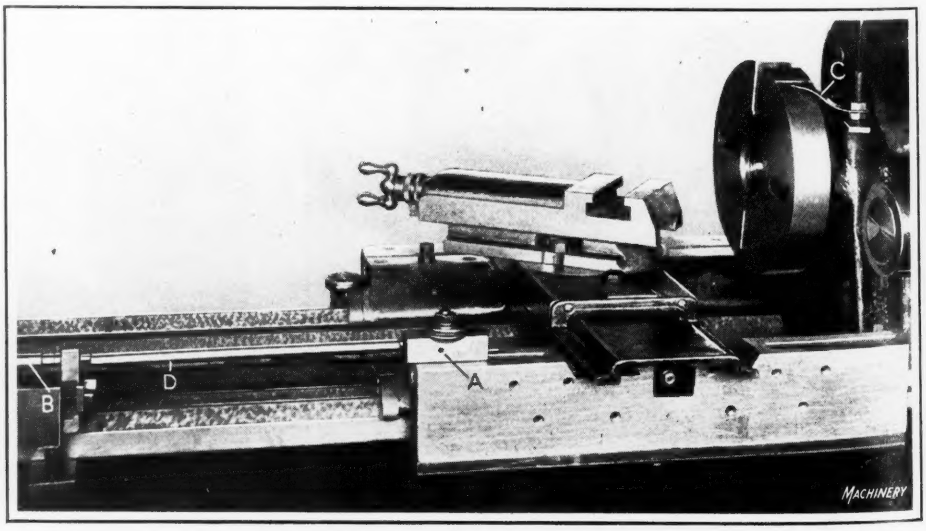


Fig. 11. Testing Lead-screw in Relation to Feed of Carriage

chased, and as they are 12 per inch, only one thread on a 4-pitch lead-screw will be used in cutting three threads on the specimen. The error in lead on the specimen must not exceed 0.0002 inch in 3 inches. Hence this test furnishes an adequate means of determining the truth of the lead-screw thread. The dimensions in this illustration are only approximate. The specimen is also finish-turned on the lathe and checked for straightness and concentricity. This actual working test is especially important on the smaller sized lathes, such as are used for tool-room work.

Aligning the Taper Attachment and Other Detail Tests

In aligning the taper attachment, a straight cylindrical test bar is placed between the lathe centers, as shown in Fig. 10, and with the cross-slide connected to the attachment and the swivel bar of the latter loose on its base, an indicator mounted on the cross-slide is run back and forth along the test bar for its entire length. The swivel bar of the attachment is shifted until the indicator reading is zero all along the bar, when a line is scribed at *A* on the swivel bar opposite a zero graduation on its base. Care must be taken in performing this test to see that the tailstock is set properly.

There are many other detailed inspections which are not of sufficient interest to describe here but which have an important influence in the building of an accurate lathe. A complete inspection system is used in all manufacturing departments, and in the drilling department, for instance, although nine-tenths of the work is performed with jigs, one piece of every lot is carefully examined so as to check the tools being used. Gear centers are particularly checked by inserting hardened plugs in the holes provided for the gear studs or shafts and then determining the exact distance between the plugs by the use of Johansson gage-blocks.

As work reaches the stock-room, it is carefully examined to see that no operation has been missed. In this way delays are reduced in the assembling department, because uncompleted work can be immediately returned to the manufacturing departments for completion before it is ordered by the assembling departments. When work is sent from the stock-room to the assembling departments, it is checked a second time. Scleroscopic and analytical tests are also made on raw materials.

After the assembly of the machine, the operation of all levers, the engagement of gears, and the functioning of automatic stops are checked. When a machine has finally been inspected as described in this article, it is run from six to ten hours at the various speeds and feeds. Before a lathe leaves the erecting floor, the form shown in Fig. 12 is filled out by the inspector assigned to that particular machine, approved by the chief inspector, and then filed as a permanent record.

THE AMERICAN TOOL WORKS COMPANY.

Machine Order No. ______ Construction No. 53623

LATHE INSPECTION RECORD.

Size 16 x 8 Bed ______ Type of Head Single Back Gear

Swings over V's 18 1/2 Over carriage wings 18 1/2 Over bottom slide 10 1/4 Over taper attachment slide —

Takes between centers ______ Tailstock flush 4' 6 3/4" Tailstock extreme 4' 9 3/4

Type of tool rest Compound Type of thread cutting mechanism Regular

ALIGNMENT RECORD.

Length of Test Bar 18"

	TOP	SIDE		TOP	SIDE
Live Spindle with Bed	Up .001	To rear	Tailstock Spindle with Live Spindle	Up	To rear
	Down	To front .0005		Down .0005	To front .0005
	Straight			Straight Yes	

FACING TEST.

Diameter of plate 1 7/8" Hollow ______ Straight Yes

RUNNING TEST.

Bore in Spindle runs .0005 out in 18" inches length — Back gear runs OK Make of chuck ______ Runs ______

Bush in Spindle runs .0005 out in 16" inches length — Chuck fitted none No. of jaws ______ Type ______

TAPER ATTACHMENT.

On carriage? no On bed? no

Parallel with bed? ______ Is carriage drilled for taper attachment? Yes

GENERAL.

Tool post takes 5/8 x 1 1/8 tool Spindle hole takes bar 1 1/4 dia. Tailstock spindle graduated in Inches

SPECIALS AND REMARKS.

Aligned by Malott Approved Wm B Wessels Inspector

THE AMERICAN TOOL WORKS COMPANY.

Dates of Inspection. Mar 7/24

Form 56A. 3-17 5M.

Fig. 12. Permanent Record filled out by the Inspector of Each Lathe and approved by the Chief Inspector

USE OF THE MOTOR SHIP

Although the history of the motor ship began only twelve years ago, when the Danish ocean-going ship, the *Selandia*, was built, the progress that has been made in the building of ships of this type has been exceedingly rapid. In 1923 there were 1831 sea-going motor ships in service, having a combined tonnage of 1,668,000. Of all the sea-going ships under construction in December, 1923, 35.5 per cent were Diesel engine ships. At present there are ten passenger liners of this type being built, with a combined tonnage of 158,000, the largest one being a 22,000-ton ship, with 20,000 indicated horsepower engines. The fuel consumption of a Diesel engine ship weighs only from 20 to 25 per cent of the coal that would be required for a corresponding coal-fired steamer, and from 35 to 45 per cent of the oil required for an oil-fired steamer. For equal dimensions and speed, therefore, the motor ship has a dead weight capacity from 5 to 15 per cent greater than a steamer. A smaller engine room staff is required, but the average pay is higher, and the saving in wages is usually not more than 5 per cent. The disadvantages of the motor ship that partially offset these decided advantages are relatively higher first cost, greater consumption of lubricating oil, and the limited supply of engineers available capable of handling Diesel engine ships. In a comparison between two 10,000-ton ships in actual service, it was found that the fuel cost of the motor ship was only 46 per cent of that of the oil-fired steamer.

Using an Optical Projector for Cutter Forming

By R. GRANT
Tool-room Foreman, Bausch & Lomb Optical Co.
Rochester, N. Y.

THE necessity for duplicating small gear-cutters for gears having a circular pitch of say 0.050 inch, which corresponds to a diametral pitch of about 63, led to the use of an optical projector in a rather novel manner. This article will be confined to a description of the procedure followed in duplicating the established tooth form with the aid of the projector and will not deal with the development of the tooth form itself. Starting with a sample rack and pinion that have been found to have a satisfactory rolling action, the various steps in making a master forming cutter *C*, Fig. 2, for use in producing duplicate working cutters will first be outlined.

Fig. 1. Using Optical Projector to observe Progress of Lapping Operation on Forming Tool

Procedure in Producing Master Forming Tools

The first step consists of making a greatly enlarged outline of the tooth profile or tooth space of the sample gear, pinion, or rack that is to be duplicated. This outline is traced on a piece of heavy paper from a photographic negative of the tooth space of the sample, which is made by means of the optical projector in a manner to be described later.

The second step is to produce a forming tool *A*, Fig. 2, which matches the tooth space of the sample, the contour of this tool being worked down and corrected until its projected profile exactly matches the enlarged outline traced from the photographic negative of the tooth space of the sample gear, pinion, or rack.

The third step is to make a temporary working cutter *B*, by forming the cutter with the tool *A*, care being taken to work the cutter down to give the correct tooth thickness without changing the position of the cross-slide after it is once set. This precaution is necessary in order to keep both sides of the cutter teeth alike.

The fourth step is to cut a tooth space in a brass dummy or blank of the same diameter as the master tool *C*. It may be well to mention here that the master tool *C* is subsequently employed to produce regular working cutters like the temporary one shown at *B*. The tooth space is cut to the correct calculated depth in the brass blank by using the temporary cutter *B* as a forming tool. The dummy or blank is mounted between the lathe centers and the cutter clamped to a shank held in the lathe toolpost. For this operation, the cutter *B* is so positioned that the face of one tooth is located 1/10 inch below the center of the dummy and held in this position where it serves as a forming tool. It is evident that the tooth space cut in this manner has the exact contour required for the master forming tool *C*, to give the cutting face at *E* the same profile as the gear tooth to be duplicated.

The fifth step is to cut away a section of the brass dummy so that the profile of the tooth space can be seen in a radial plane. An enlarged photographic negative of this profile is made, and a tracing of the negative produced as previously described, which is employed as a guide in working down the pieces shown at *D* to the correct form before they are assembled and the side of the assembled cutter gashed, as shown at *C*.

Making the Master Profiles

In making enlarged master profiles for use in duplicating cutters having teeth as fine as 63 diametral pitch, the magnification should be about 300 times. In the present instance, a 14- by 17-inch dry plate negative held in a standard plate-holder is used with the Bausch & Lomb contour projector. In order to obtain the required magnification, it is necessary to swing the prism aside and project straight through the optical system to a screen on the wall.

The projector must be so adjusted that the ray of light will be at right angles to the screen and the correct amount of magnification will be obtained. In order to adjust the equipment to meet these requirements, an accurately made bushing is placed in the V-block which is part of the projecting equipment. Through the center of this bushing and coinciding with its axis, is a small hole drilled with a No. 60 drill. This hole is lapped smooth and round, and the outside of the bushing ground so that it is parallel with the hole. For the outside grinding operation, the bushing is mounted on a piece of drill rod ground to a wringing fit for the small lapped hole. When the projector is adjusted so that the light passing through the hole in the bushing forms a true circle, the equipment is properly squared up and is ready for use.

The amount of magnification is determined by measuring the width of the projected shadow of a wire of known diameter. The precision wire employed for the three-wire method of measuring thread gages should be used for this purpose. In this case, a wire having a diameter of 0.010 inch may be conveniently employed. Having made the negative which shows the outline of the tooth space, it will be seen that the line of demarkation at a magnification of 300 times is rather blurred and has slight irregularities in the curves. These irregularities, however, represent a fraction of one thousandth of an inch if the samples are of good quality.

The outline of the tooth space is transferred from the negative to heavy drawing paper by using a frame deep

enough to accommodate an electric light placed under the negative, the drawing paper being placed over the negative. The slight inaccuracies of the negative are eliminated by using a draftsman's curve when tracing the outline. The center lines, base, and pitch lines are established, and if the tooth space is found to be unsymmetrical, it is corrected according to the judgment of the designer. The result is a clean-cut outline on durable paper which becomes the master chart or profile record. In order to preserve the chart, it is well to mount it on a piece of sheet iron and coat the surface with shellac, preferably spraying the shellac on the tracing.

Finishing the Master Forming Tool

Having made the three parts of the master forming tool as shown in the sectional views at *D* so that the curve formed when the parts are assembled closely approximates the required shape, the parts are hardened and ground all over except on the curved portions that form the tooth. One of the side sections of the tool is then mounted on a quill, the holder of which is, in turn, mounted on the cross-slide of the optical contour projector, as shown in Fig. 1. The quill is driven by a small round belt from a motor secured to the floor, an electric center grinder being satisfactory for this purpose.

With the side section mounted on the quill or spindle in the manner described, it is possible to lap and polish the tooth curve until the projected contour coincides exactly with that of the enlarged chart or master profile on the wall. With this arrangement, the workman can watch the progress of the lapping operation without removing the tool from the rotating spindle. Both halves of the tool are finished in the same manner, while the central section or spacer is lapped to the thickness required to give the cutter the correct width at the pitch line. It is generally necessary to employ the cut-and-try method in lapping the spacer to the required thickness.

It may be well to mention here that the procedure outlined in this article is practicable only when the production of gears is continuous and when each gear is required to be the exact duplicate of the others with respect to the tooth profile. There are, however, many cases in which the projector can be used to advantage in the duplication of profiles or contours without necessitating so many steps. For instance, a forming tool similar to the one shown at *A*, Fig. 2, having sufficient accuracy for certain purposes may be developed by plotting the profile on the chart and grinding and lapping the forming tool until its projected profile coincides with the one plotted on the chart.

The amount of magnification must, of course, be carefully calculated or determined. If one side of the tool is carefully ground and care taken to keep this side vertical in the projector while correcting the contour, the tool can, by

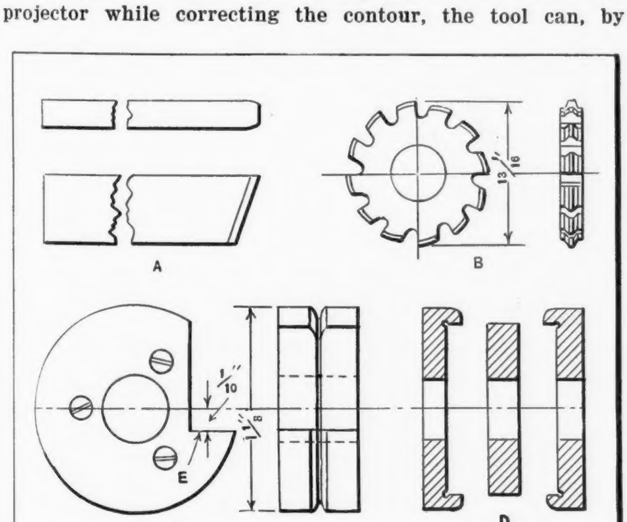


Fig. 2. Forming Tools used in producing a Gear-cutter

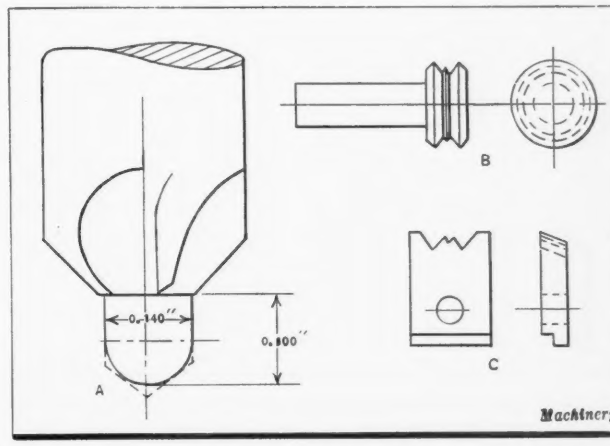


Fig. 3. Examples of Work produced by the Aid of the Projector

proper setting in the lathe, be employed to turn both sides of the milling cutter symmetrical with respect to the center line. By using the forming tool alternately on each side of the work cutter and checking its profile frequently with the outline on the chart, very little trouble is experienced in producing a milling cutter that is accurate within very close limits.

The countersink shown at *A*, Fig. 3, is another example of tool work that can be handled advantageously on the projector. This countersink is used for chamfering the edge of a hole so that the chamfer will be at a given distance above a ball placed in the hole. The difficulty encountered in measuring a countersink of this kind by ordinary means is obvious. It is a comparatively simple matter, however, to produce this countersink by the use of the projector and an outline showing the radius of the pilot and the outline of the cutter edge in their correct relative positions. The outline used in this case may be about fifty times the actual size.

At *B* is shown a circular forming tool having three different angles, the larger diameter of the tool being about ½ inch. The master tool *C* for forming the circular cutter *B* is mounted in the projector after it has been milled or planed as nearly as possible to the required shape. The cutter can then be corrected without being removed from the projector, in the manner previously described.

* * *

STANDARDIZATION OF PINS AND WASHERS

The standardization of pins and washers is to be taken up on a national scale under the auspices and procedure of the American Engineering Standards Committee. The work, which will include taper pins, split pins, straight pins, dowel-pins, plain washers, and lock washers, will be carried out by a thoroughly representative sectional committee working under the sponsorship of the American Society of Mechanical Engineers. The standardization of these parts was proposed by the United States War Department on account of difficulties that had been encountered in securing these small but important supplies, made interchangeably, from different industrial sources; and a special committee found upon investigation that there was a general desire for national uniormity in this respect.

* * *

MACHINERY EXHIBITION IN ENGLAND

The next shipping, engineering, and machinery exhibition to be held at Olympia, England, will take place November 23 to December 5, 1925. American manufacturers will be invited to exhibit at that time, and a portion of the exhibition building at Olympia will be set aside as an American section. In order to provide American firms interested in the project with all the necessary information on the subject, the general manager of the exhibition, Frederic W. Bridges, will spend some time in the United States this fall. He expects to reach New York about the middle of October.

WIRE ROPE TESTS

Experiments made at the Bureau of Standards indicate that a six-strand, nineteen-wire, plow-steel, ⅝-inch wire rope, when bent over a 10-inch sheave, loses 12.6 per cent of the strength that it has when straight, and when bent over an 18-inch sheave, 4.7 per cent. A 1¼-inch rope loses 24.2 per cent, when bent over a 10-inch sheave, and 15.3 per cent on an 18-inch sheave. The wires of which the ropes were composed had a strength of 230,000 pounds per square inch, and the strength of the rope itself, when straight, equaled $83,000d^2$, in which d is the diameter of the rope in inches. The modulus of elasticity of steel wire rope may be assumed to be about 8,500,000.

SOLDERING FLUXES

In order to obtain a good joint by means of soldering, it is necessary that there be more than mere adhesion between the solder and the metal. There must be an alloy formed between the metal and the solder, and, in order that this alloy may be formed, the surface of the metal must be entirely free from foreign substances, such as oxides, oils, or various kinds of solid matter. This is accomplished by using a flux that melts at the fusing temperature of the solder and thus excludes the air. The flux used in any case depends somewhat upon the nature of the work. The fluxes generally used for soft soldering are rosin, sal-ammoniac, and zinc chloride, although there are many others employed. For hard soldering or brazing, pulverized borax or boracic acid in powdered form are commonly used. Another flux that has given good results is made of equal parts, by weight, of borax and potash, this mixture being melted and, when cool, pulverized.

NIBBLING MACHINE

The "nibbling machine" is so named because it is used for cutting sheet metals to any desired outline, by means of a rapidly reciprocating punch which takes numerous small cuts. The punch is of small size and enters a die held in the bedplate. Sheet steel can be cut out to the contour of super-imposed templets. This machine is intended for use where conditions do not warrant making a blanking punch and die for use on a power press.

AIR RESISTANCE

The resistance of still air to the moving parts of machinery often is not considered. Yet still air may offer considerable resistance to parts having a certain form and moving at high speed, as is evidenced by the airplane which is lifted by the action of the propeller and planes against air resistance. Covering large rapidly revolving flywheels on both sides with light plates has a marked effect in reducing the air resistance of the spokes. This is rarely done, however, because of its first cost and appearance. In calculating the power necessary to move a vehicle or projectile, consideration must be given to the resistance of either still air or wind against which it is forced. The wind exerts pressure on sloping roofs and the sides of all buildings, towers, bridges, or any other structure, and they must be able to resist collapsing or overturning because of this force. Even wires have considerable wind resistance, which is increased greatly when they are covered with sleet. So-called "holes" in the air, met with by aviators, which are probably due to variations in the velocity of the air movement at a certain point, require an additional factor of safety in airplanes due to the stresses produced by a sudden dropping of a plane.

STEAM QUALITY

The percentage of dry steam in steam containing moisture, is called the quality of the steam. For example, if a pound of a given sample of steam contains 0.04 pound of water in the form of spray, and 0.96 pound of dry saturated steam, the quality is said to be 96 per cent. It is very important to know the quality of the steam when testing a boiler for capacity and fuel consumption, as water carried over in the form of spray has no value for the generation of power in a steam engine, or for heating purposes. As the quantity of steam evaporated in a given time is found by weighing the feed water, it is evident that the moisture contained in the steam will appear in the result, unless its percentage is known and the necessary correction made. The proportion of moisture in steam is found by means of a device called a calorimeter, which forms an important part of the equipment used in boiler testing.

SILICON CARBIDE

The artificial abrasive produced from a coke and sand mixture is known as silicon carbide. The electric resistance furnace is used in its production. Wheels made from this abrasive are adapted for grinding materials of low tensile strength, such as soft brasses and bronzes, cast and chilled iron, aluminum, copper, marble, granite, leather, and other non-metallic substances.

SNAGGING CASTINGS

All castings poured in foundries must be "cleaned" before shipment. In this cleaning process, grinding is very important, both in the cast iron as well as in the steel foundry cleaning room. This grinding or "snagging," as it is usually called, consists of removing from the surface of the castings any irregularities and projections left after the gates and risers have been broken or cut off. In addition, many castings have a protruding fin which is formed when the molten metal flows into the parting line between the cope and nowel of the molding flask. Because of the efficiency of the modern special-purpose grinding wheel in removing metal rapidly and cheaply, it has often replaced pneumatic chipping (cold chiseling) hammers for this class of work, except for large castings of comparatively soft material and large irregular-shaped castings on which it is impossible to use a grinding wheel. Manganese steel and some other alloy steel castings, because of their extreme hardness and toughness, must be ground. Every foundry, therefore, has a cleaning room containing grinding equipment.

WORK-BENCH HEIGHT AND LOCATION

The height of work-benches usually varies from 32 to 36 inches from the floor to the top of the bench, the height depending somewhat upon the nature of the work, lighter work being done on higher benches. For general purposes, the height should be about 34 inches and the width about 30 inches. The top is ordinarily composed of heavy planks, 2 or 3 inches thick, in the front, and lighter 1-inch boards in the back. The thickness of the front planks is varied in accordance with the weight of the work for which the bench is intended. Maple and ash are considered the best woods for bench planking. The preferable position for benches, especially if used for fine accurate work, is the north side of the building, because the light on that side is more even throughout the day. The clearance space or gangway between the bench and the end of any projecting machine handles, handwheels, etc., should not be less than 2 feet 10 inches.

GASOLINE VAPOR

Gasoline readily vaporizes when exposed to the air of any temperature down to 15 degrees F. below zero. The vapor is nearly three times as heavy as air, and when mixed with the proper quantity of air becomes violently explosive. If confined where there is poor ventilation, this mixture will sometimes remain in the explosive condition for several months. The vapor will ignite from an open flame, a spark from a grinding wheel, a sufficiently heated surface, and even from a spark of static electricity from the human body.

RIVET DRIVING

In driving cone-head or button-head rivets, they should be "plugged" squarely into the hole, care being taken not to bend over the point of the rivet but to upset it, filling the hole its entire length. A riveting hammer should be powerful enough to form a perfect head without rocking the hammer to work down the edges. The hammer should be started lightly until the rivet has settled into the hole somewhat, to prevent bending to one side. In driving any kind of rivets held or backed up by a dolly-bar or hand-hammer, the riveter must learn to run the hammer slowly until enough head is formed to hold the rivet in the hole, as otherwise the holder-on will have difficulty in keeping the hammer or dolly-bar on the rivet. Getting the rivets into the holes hot and "getting the heads up" is a necessary preliminary to obtaining tight work. For holding the rivet in position, there must be sufficient weight behind it to form a solid anvil against which it may be headed.

PINION BLANK ENLARGEMENT

When an ordinary pinion is used (having a pressure angle of 14½ degrees) twelve teeth is generally considered the minimum number if the addendum conforms to the usual standard. Even with a pinion of this size, the flanks of the teeth must be under-cut somewhat to avoid interference, provided the mating gear has more than twelve teeth, and this interference and the need for under-cutting increases if the pinion is to run with larger gears. A method of improving the shape of the pinion tooth that has long been employed consists in enlarging the pinion blank and reducing the gear blank a corresponding amount. Another method is to increase the pressure angle of the gearing, and a third method consists in modifying both the pressure angle and the blank diameters in order to obtain a tooth shape giving the best results. Enlarging the pinion blank and decreasing the gear blank a corresponding amount (if the center distance is to remain the same) is applied not only to spur gears but also to bevel gears, worm-gearing, and herring-bone gears. In cutting an enlarged pinion or a reduced gear (whether by hobbing or on a generating shaper or planer) the procedure is the same as for cutting standard gear teeth, and any generating type of machine may be used. The teeth are cut to the full depth on both pinion and gear, and in the usual manner, but if the position of the cutter relative to the gear blank is checked by measuring the tooth thickness, then the change in the height of the pinion and gear addendum must be taken into account, the tooth thickness being measured where the pitch circle crosses the tooth in each case. When the pinion blank is enlarged and the gear blank reduced, without changing the pressure angle, the practical effect is to move the pinion teeth outward radially and the gear teeth inward a corresponding amount relative to the pitch circles as well as to the base circles from which the tooth curves are derived.

AMERICAN STANDARD TAPER PIPE THREAD

The American standard taper pipe thread was formerly known as the American Briggs standard. The form of the thread is a 60-degree vee, truncated equally top and bottom by an amount equal to 0.033 times the pitch of the thread. The taper of the thread, on the diameter, is 1/16 inch per inch or ¾ inch per foot. As far as the thread on the product is concerned, no change has been made from the former American Briggs standard; but to allow for a reasonable amount of wear on the taps and dies, thus making for more economical production, a modification has been made on the gages. This consists of reducing the crest of the thread gage by truncating it an amount equal to 0.10 times the pitch from the theoretical sharp point. If an old gage is correct in all other respects, it can easily be made to conform to the present standards by grinding off the excess metal at the crests of the threads. This taper thread can be used for threaded joints for any service.

BULGING PROCESS

In the manufacture of many sheet-metal parts, operations such as bending, forming, and expanding can be performed economically by "hydraulic bulging." With one method, the work is placed in a die, which is usually split, and water under a pressure varying from 600 to 1200 pounds per square inch is admitted from either a hydraulic accumulator or a force pump. A force pump is generally sufficient for the purpose, and gives a ready means of varying the fluid pressure; the initial cost is also low. In the case of hollow work, the water under pressure is admitted directly into the work itself, so that in this respect it differs from the older method of hydraulic bulging, in which the quantity of water is measured, put into the receptacle to be bulged, and the operation performed under a power press. The finish produced by this bulging method is quite free from tool marks, and all bends are of full section throughout. An important point to be considered is the water pressure, which must be governed by the thickness of the metal and its physical characteristics. A safe pressure to use at first is about 700 pounds per square inch for annealed brass 0.020 inch thick, increasing this to approximately 1200 pounds per square inch for a thickness of 0.060 inch. If the pressure is excessive, it may burst the end of the shell, and so it is advisable to increase the pressure gradually until the desired results are obtained. An operation such as bending a tube requires more pressure than a simple expanding operation, since, in bending, the tube must be forced around a curved recess in the die.

STEEL PIPE TEST

Wrought-iron pipe may be distinguished from steel pipe by testing the material in the pipe for manganese, which is present in the steel pipe, but is not present, except possibly as a trace, in wrought iron. A method of making the manganese test is as follows: Place a clean, bright chip or filing of the metal to be tested, about the size of a pin-head, in a porcelain crucible; add six drops of pure nitric acid, and heat; add two drops of silver nitrate solution, then one crystal of ammonium persulphate not greater than ⅛ inch in diameter; warm the solution, but do not let it boil. If the metal is steel, a pink color will begin to develop, and at this point the crucible should be removed from the source of heat, when a very decided red coloration will result. If no color develops, but a small amount of dark residue remains in the dish, the metal is wrought iron.

Notes and Comment on Engineering Topics

France leads in the construction of reinforced concrete bridges of great span. Recently such a bridge was completed in France in which the span of the arch was approximately 600 feet. Another bridge is now being planned that will have three spans, the lengths of which will be approximately 680, 645, and 620 feet, respectively. This bridge will be erected during the next three years at Brest. The height of the arches will permit a free opening for navigation, 230 feet wide by 120 feet high.

Aluminum alloy wheels for omnibuses have been experimented with by the London General Omnibus Co. in England. These wheels have only half the weight of a standard steel wheel, and many of them have now been running over 30,000 miles in regular service. The advantages claimed for these wheels are that there is a reduction in the unsprung weight of the vehicle, that the destructive action on the roads is reduced, and that the scrap value of the wheels is high—about two-thirds of the original value.

Artificial lumber is the next step in the development of the lumber industry. While no artificial lumber is yet on the market, it is stated that experiments carried on in the Northwest have proved that branches of young trees, and even leaves and wood refuse, can be ground up and mixed with other substances so that a compound is produced which can be molded into shapes for use as a substitute for lumber in building construction. In the past, from the time of the standing tree until it is turned, by the saw mill, into planks and boards, 60 to 65 per cent of the actual wood has been wasted, including the stumps, chips, bark, branches, trimmings, and sawdust. By the new method, all of these by-products could be used in the production of artificial lumber.

The ability of the Diesel engine to operate continuously for a long period of time is not, perhaps, generally known. It is, therefore, of considerable interest to note that a Diesel engine built by the Worthington Pump & Machinery Corporation has been running in the power plant of the city of Horton, Kan., without a stop for 202 days, driving an alternating-current generator in parallel with another unit for producing electric current for lighting and power. This gas engine is of the four-cycle air injection type, operating at 225 revolutions per minute and developing 562 horsepower. It has three cylinders, each 22½ by 22½ inches, with oil-cooled pistons and lubricant forcibly fed to all parts of the engine. The machine was not shut down at the end of the 202 days run because of any mechanical trouble that had arisen, and was apparently capable of continuing the run.

An interesting machine for winding magnetic coils has recently been installed by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., to replace the winding machines operated by girls, which have been used in the plant for many years. These automatic machines perform the winding operation not only more economically but also in a more satisfactory manner. The machine can wind coils from ¾ inch up to 6 inches in diameter, with a maximum length of 3¼ inches. The most interesting feature of the automatic winder is that it winds a self-contained coil and builds up, at the same time, a retainer of cotton in the form of a round disk or washer at the end of each coil. When the required amount of wire is wound on the coil, or in the event of breakage of either the wire or the cotton, an automatic electric stop motion cuts off the power and stops the machine. This operation lights a lamp which indicates to the attendant that the machine is not running.

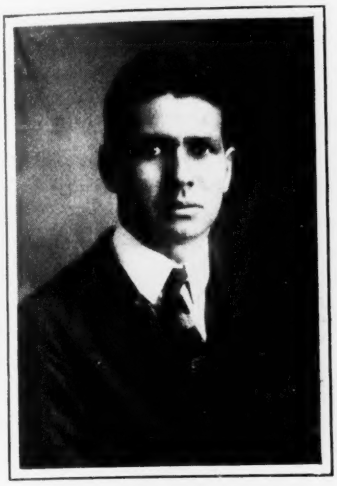
The first step in the development of hydro-electric energy in the Clarence River Valley, Northern New South Wales, is taking place under the direction of an English company. The site of the power house is near the township of Nymboida where the river attains its greatest volume. The estimate of the capital required is £100,000. Current will be generated at the power house at 6000 volts and stepped up to 33,000 volts for transmission to South Grafton and Ulmarra. The transmission line is being constructed at these centers with a capacity of 1200 kilowatts, and at both places sub-stations will be erected from which electricity will be distributed throughout the towns and adjoining districts. The new plant will enable factories to be built along the Clarence, and is a part of a movement to counteract the tendency of centralizing industrial undertakings in the large cities, in order to bring the factory nearer to the source of raw material.

A new process for repairing locomotive guides has been developed by the General Electric Co. The process involves the use of electric arc welding, automatically applied. The guides are placed in an ordinary lathe and the automatic electric arc welding appliance is mounted in the toolpost. When the operation is performed, the guide remains stationary and the automatic welder travels along with the carriage of the lathe, depositing electrode metal on the worn surface. In this way the worn spots on the guides can be built up to any required thickness, the built-up surface afterward being machined. In one case, a total thickness of ⅜ inch was built up, of which ⅛ inch thickness was machined away on each side, the length of the built-up guide being 5 feet. A total of three hours was required for welding both sides. Figures obtained from a railroad now using this process indicate that a saving of almost 50 per cent has been accomplished by the automatic electric arc welding method, as compared with previous methods.

The problem of improving the safety of marine and aerial navigation in time of fog has always been an important one, and many aids to such navigation have been established. One of the latest and most effective of these is the radio direction finder installed on shipboard and used in conjunction with a radio beacon installed on light ships. The beacon consists, briefly, of two transmitting coil antennae arranged at an angle of about 135 degrees with each other, signals being transmitted alternately from each coil antenna. An airplane or ship equipped with an ordinary receiving set can, by the aid of the signals received follow a definite course in foggy weather simply by navigating so that the signal strength from the two coils remains equal. While this aid to navigation may be effective only over definite routes or courses, it has the advantage over other methods of direction-finding in that no special receiving apparatus is necessary and that it gives an immediate indication of any alteration in the course caused by drift from wind or tide. The method and equipment is described in Scientific Paper No. 480 of the Bureau of Standards, published by the Department of Commerce, Washington, D. C.

Design of Helical Springs

By J. W. ROCKEFELLER, Jr., Manager, Spring Division, John Chatillon & Sons, New York City



J. W. Rockefeller, Jr.*

SINCE Robert Hooke discovered, in the seventeenth century, that springs obey certain well defined laws, a very wide application has been made of them. Not long after Hooke made his initial researches, he produced the first spring watch which, together with the principle of the spring balance, was demonstrated before Charles II of England about 1675. During the two hundred and fifty years that have elapsed since this demonstration, the use of the spring watch and spring balance has become universal. In the same two and a half centuries, however, the laws underlying spring performance have remained somewhat of a mystery to many mechanics and machine designers. Until recently no attempt had been made even to so much as standardize spring terminology. For the benefit of those who cannot afford to devote much time to the subject of springs, but who, nevertheless, wish to absorb a few of the more pertinent facts regarding them, the writer has prepared this article which will facilitate the solution of many spring problems.

Deflection of Helical Springs

The formula for determining the deflection of a helical spring under a given load is usually expressed as follows:

$$F = \frac{8WD^3N}{Gd^4} \qquad (1)$$

in which

F = deflection, in inches;
W = weight imposed on spring, in pounds;
D = mean diameter of coil, in inches;
N = number of coils;
G = torsional modulus of elasticity of the spring material, (for steel, about 12,000,000); and
d = diameter of wire.

In actual designing, the solid height of the spring is of greater importance than the number of coils, and in an extension spring of many coils, this value is more easily determined by direct measurement. For these reasons the writer prefers to use this formula in a slightly modified form as follows:

$$F = \frac{8WD^3H}{Gd^5} \qquad (2)$$

in which H = solid height of coil.

*J. W. ROCKEFELLER, JR., author of the series of five articles on spring making and spring design that have appeared in MACHINERY beginning with the July number, and of which this is the last, is a graduate of the Massachusetts Institute of Technology. After his graduation, he entered the Engineering Service Department of John Chatillon & Sons, of New York City, where at the present time he is manager of the Spring Division, having charge of spring design and production. When the Spring Research Committee of the American Society of Mechanical Engineers was formed, he was appointed a representative of the American Society of Steel Treating on this committee, and at its first meeting in Cleveland in May of this year was elected secretary of the committee. In addition to his engineering work, he has also instructed evening laboratory classes at the Brooklyn Polytechnic Institute in metallography.

With this formula, as well as with the formula later used to determine the maximum fiber stress, the third and fifth powers of diameter d given in the accompanying table, may be used to facilitate calculations. The sizes chosen for d are the decimal equivalents of W & M gage sizes.

By studying these formulas it will be learned that the spring becomes more flexible, or stretches more, when subjected to a given load, under the following conditions:

1. As the mean diameter of the coil is increased.
2. As the solid height of the spring is increased.
3. As the modulus of elasticity of the spring material is decreased, that is, as a material having a lower modulus of elasticity is substituted.
4. As the diameter of the wire is decreased.

How to Calculate a Spring of Varying Coil Diameter

Often the diameter of the coil is not a constant, but varies from one end of the spring to the other. In such cases, the writer has found it convenient to plot the factor D^3H of the deflection formula on paper as an area in the manner to be explained. First, assume the spring to be closed solid, and then lay off this solid length as a horizontal distance on the chart. Divide this line into a convenient number of equal parts; the greater the number of divisions, the closer will be the approximation of deflection arrived at. At the equal division marks lay off vertical distances equal to the third power of the coil diameter at those points. Finally, connect these points and drop perpendiculars from the ends of the curve thus formed to the horizontal line that represents the solid height. The area enclosed by the curve, perpendiculars, and the horizontal line may be determined by a planimeter measurement or by any one of the various approximate methods for finding areas. This area is equal

TABLE OF THIRD AND FIFTH POWERS OF SPRING-WIRE DIAMETERS

W & M Gage	Diameter d	d^3	d^5
00	0.331	0.0363	0.00400
0	0.307	0.0289	0.00270
1	0.283	0.0227	0.00182
2	0.263	0.0182	0.00126
3	0.244	0.0145	0.000864
4	0.225	0.0114	0.000578
5	0.207	0.00887	0.000380
6	0.192	0.00708	0.000261
7	0.177	0.00555	0.000174
8	0.162	0.00425	0.000112
9	0.148	0.00324	0.0000711
10	0.135	0.00246	0.0000449
11	0.120	0.00173	0.0000249
12	0.105	0.00116	0.0000128
13	0.092	0.000779	0.00000660
14	0.080	0.000512	0.00000328
15	0.072	0.000373	0.00000194
16	0.063	0.000250	0.000000993
17	0.054	0.000157	0.000000459
18	0.047	0.000104	0.000000230
19	0.041	0.0000689	0.000000116
20	0.035	0.0000429	0.0000000525
21	0.032	0.0000328	0.0000000336
22	0.028	0.0000220	0.0000000173
23	0.025	0.0000156	0.00000000975
24	0.023	0.0000122	0.00000000645
25	0.020	0.00000800	0.00000000320
26	0.018	0.00000583	0.00000000189
27	0.017	0.00000491	0.00000000142
28	0.016	0.00000410	0.00000000105
29	0.015	0.00000337	0.000000000759
30	0.014	0.00000274	0.000000000538

Machinery

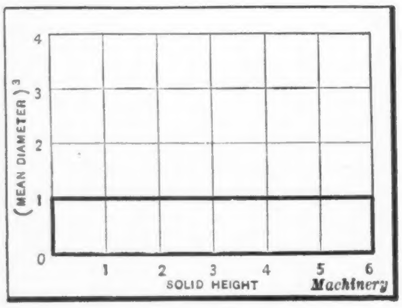


Fig. 1. Diagram illustrating Quick Method of finding Value D^3H

to the expression D^3H in Formula (2), and when multiplied by $\frac{8W}{Gd^5}$ will give the deflection.

As an example of this method, suppose that it is desired to find the deflection, under a load of two pounds, of a steel spring that has a constant coil diameter of 1 inch, assuming the solid height of the spring to be 6 inches and the diameter of the wire to be 0.072 inch. In this case, the area obtained by the graphical method, as shown in Fig. 1, is 6 inches long and 1 inch high, and so $D^3H = 6$. Thus,

$$F = \frac{8 \times 2 \times D^3H}{12{,}000{,}000 \times 0.00000194} = 0.687\ D^3H = 0.687 \times 6 = 4.1$$

inches

Now assume that a spring of the same dimensions, with the exception that the coil diameter tapers evenly from 1 inch to 2 inches, is to be subjected to the same load. The value to be used for D^3H in this case is found as shown in Fig. 2. Four values for D are plotted 2 inches apart along the base line; these values are found as follows: $1^3 = 1$, $1.33^3 = 2.35$, $1.67^3 = 4.66$, and $2^3 = 8$, as we progress from the small to the large end of the spring. The area under the curve equals approximately 23. Thus, the deflection in this case will be approximately $0.687 \times 23 = 15.8$ inches. The numerically exact answer as determined by mathematical integration is 15.5 inches. The answer obtained in the foregoing will approach this figure more closely as the number of equal parts into which the base line is divided, is increased.

As a final example of the method, assume that a load of 2 pounds is to be placed on a spring of the same dimensions as given in the previous two cases, with the exception that the diameter of the coil tapers from 1 inch at each end to 2 inches at the middle. The graphical solution of this example is shown in Fig. 3, the base line being again conveniently divided into four equal parts. This area is found again to be 23; hence the deflection equals $0.687 \times 23 = 15.8$ inches. While the simplest cases have been taken for these examples, it is easy to realize the possibilities of this method for determining the deflection of springs of very irregular coil diameter.

Determining the Maximum Fiber Stress

The maximum fiber stress S in a helical spring is in the outside section of the wire, and may be roughly determined by the formula,

$$S = \frac{WD}{0.4d^3}$$

Values for d^3 may be readily ascertained by referring to the table.

In using the formulas given for finding the deflection and maximum fiber stress, it must be remembered that they are simply refinements of more general static torsional formulas and must not be applied indiscriminately. As an example, let us take a helical steel pring which compresses 1 inch under a 10-pound load, the fiber stress in the steel under this load being 10,000 pounds per square inch. This spring will easily support such a load without the remotest possibility of fracture. If, however, the load of 10 pounds were dropped on the spring from a height of 4 feet, the spring would deflect 10 inches instead of 1, and the fiber stress in the steel would amount to 100,000 pounds per square inch, with the grave likelihood of ultimately fracturing the steel.

In designing valve springs or springs for other purposes where the weight of the spring must be carefully considered, it may save time to remember that for a given deflection and fiber stress under a specified load, the weight of a steel spring will remain the same, regardless of the variation in solid height, size of wire, and diameter of coil.

As a final suggestion, it may be said that after a spring has been calculated for some particular duty, it is a wise plan to consult a spring manufacturer regarding the design. It happens frequently that some slight change can be made in the original specifications which will not in any way affect the performance of the spring, but which will simplify the manufacture and consequently reduce the cost.

* * *

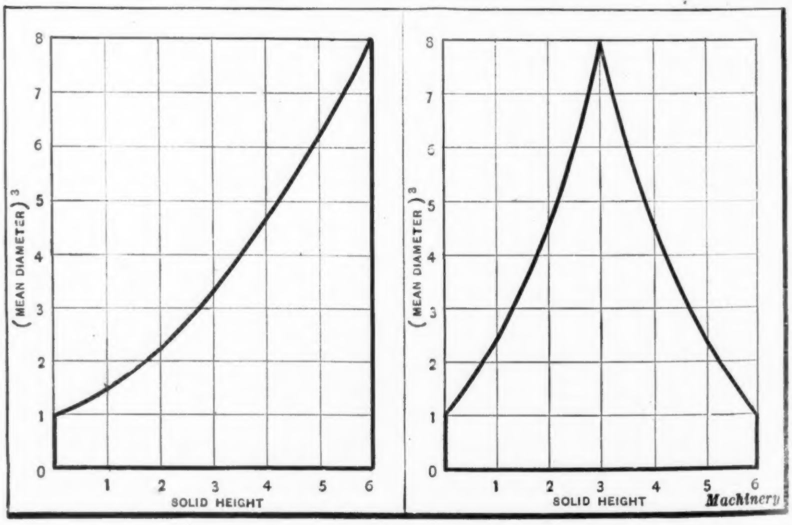
DOUBLE AND TRIPLE INSPECTION

By L. K. GOSS

Double and even triple checking of important dimensions is necessary to insure the degree of accuracy generally required in tool and gage work. The practical value of this precaution, however, is overlooked to a considerable extent in many shops. The taking of single readings with a measuring tool, or the making of several observations with the same tool, often leads to erroneous conclusions.

The case described in the following shows how trouble may arise when measurements are taken with a single instrument. An experienced toolmaker measured the pitch diameter of some thread gages with a hand micrometer and thread gage wires, and his readings were verified by the supervisor. In this case, both men used the same micrometers which later turned out to have worn anvils causing an error of 0.001 inch in the readings. This error started a very expensive controversy with one of the firm's customers which might have been easily eliminated by checking the readings with a different pair of micrometers.

As an example showing the advisability of using a triple check, there is the case of two workmen who were measuring a quantity of ground taps in order to select a few of a certain size. One workman was using the Pratt & Whitney super-micrometer, the other man the Van Keuren light wave measuring outfit. As the work progressed it was found that the men were obtaining readings that varied about 0.0025 inch. In this case a Zeiss optometer was used which agreed exactly with the measurements obtained by the light wave outfit. Investigation showed, however, that the taps were not being held correctly in the super-micrometer. Measurement authorities seem to agree that different instruments should be used in all cases where measurements of less than 0.001 inch are to be made, and the measurements should be taken by different inspectors.



Figs. 2 and 3. Layouts made to facilitate finding the Deflection of Springs having a Varying Coil Diameter

Unusual Engine Lathe Operations

Prize-winning Articles in MACHINERY's Contest on Interesting Lathe Practice—Fifth Installment

ARC GRINDING IN THE LATHE

By R. A. BLACK

The part shown in Fig. 1 is a locating plug for an inspection gage. It must be hardened and then ground all over to an exact size and shape. One of the surfaces to be ground is indicated by the arc *A* which includes three-fourths of the entire circumference. How this grinding operation was performed in a lathe is described in the following: The method usually employed for work of this kind in a toolmaking department is to revolve or rock the piece through a portion of a revolution by hand. This is a slow process at best, and as there were twelve of the pieces to be made, the writer decided to rig up a bench lathe in such a way that the work would be reversed automatically.

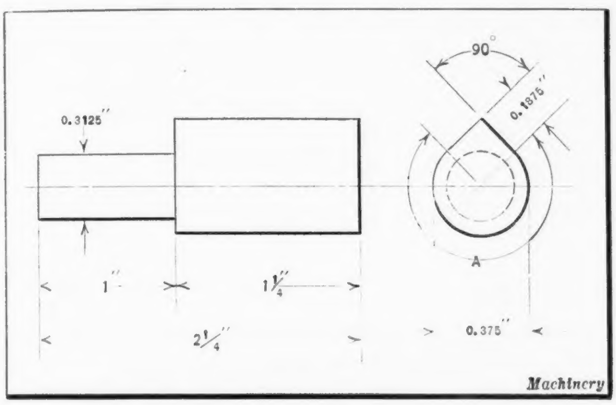


Fig. 1. Locating Plug for Inspection Gage

The bench lathe was equipped with a small grinding attachment which consisted of an arbor *B*, Fig. 3, carrying a grinding wheel *C*. The arbor was driven by a round leather belt from a countershaft located above the machine. This complete grinding attachment was clamped in the toolpost as shown. The travel or traverse of the grinding wheel was obtained by sliding the spindle through its bearings by means of the hand-knob *D* on the end of the spindle.

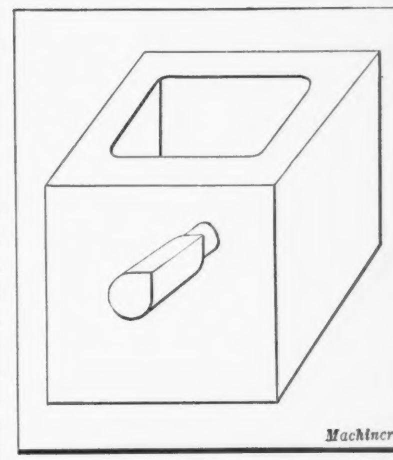


Fig. 2. Fixture used in grinding the Flat Sides of the Gage shown in Fig. 1

Method of Rocking or Oscillating the Work

The work was mounted on the lathe centers without a driving dog. A combination reversing and rotating motion was imparted to it by means of a crank and connecting-rod mechanism. The eccentric stud *E* of the mechanism served as a crank and the link *F* as the connecting-rod. It was necessary to rotate the work through three-fourths of a revolution before reversing it, and as this movement was not obtainable by a connecting-rod attached directly to the work, the work-spindle was driven through gearing in order

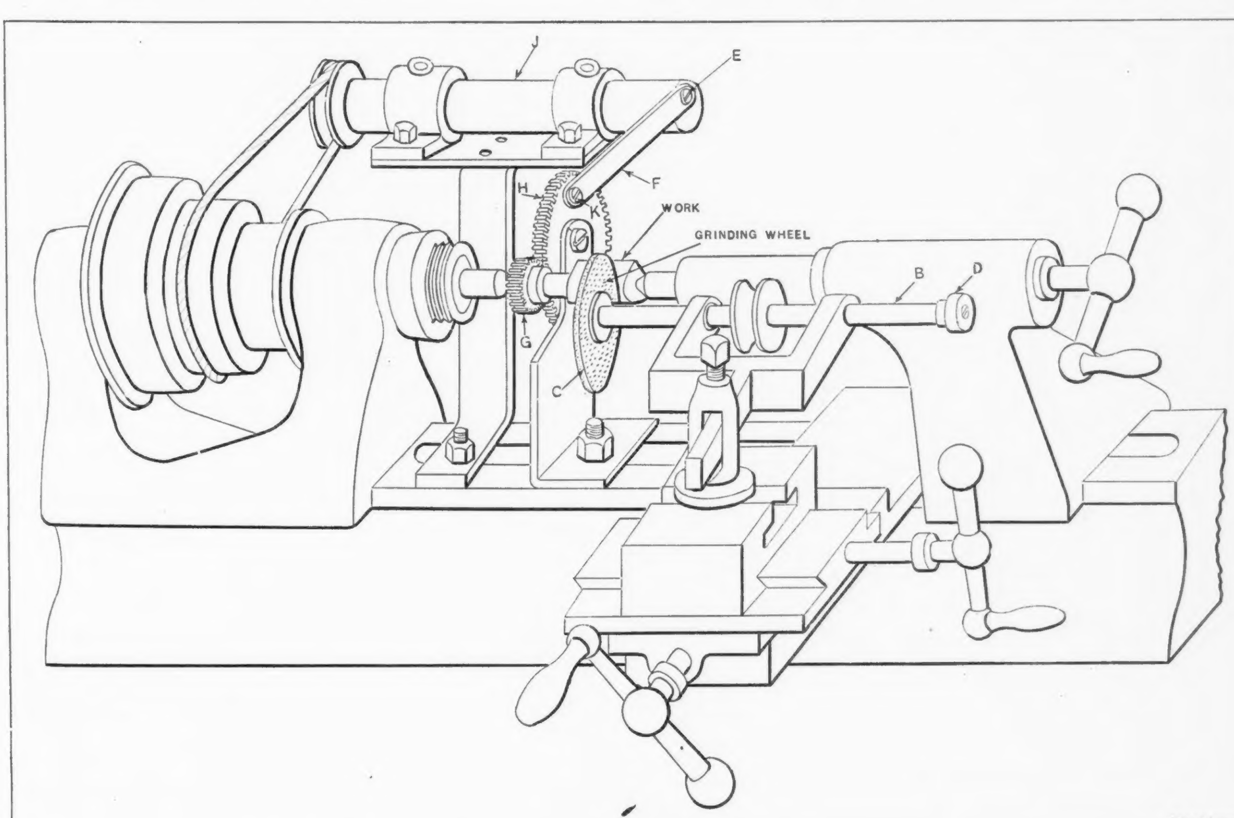


Fig. 3. Work-oscillating Fixture and Attachment used for Arc grinding

to increase the angle through which it was made to oscillate by the crank mechanism.

A small brass pinion *G* was pressed on the shank of the work as shown, and driven by a gear *H*, which had a diameter three times as large as the pinion. A 90-degree movement or one-fourth revolution of the gear thus served to rotate the pinion and the work three-fourths of a complete revolution. An oscillating movement of 90 degrees was imparted to the gear *H* by the connecting-rod, which was driven by an eccentric stud at the end of the shaft *J*. This shaft was driven by a round belt from one of the steps on the cone pulley of the lathe spindle. The bearings for shaft *J* and gear *H* were supported by sheet-steel brackets clamped to the bed of the lathe. An adjustment for the amount of throw was easily obtained by varying the distance between the stud *K* and the center of the driving gear.

Operation of Arc-grinding Fixture

In placing the work on the centers, the proper position of the flat face was obtained by sliding the pinion *G* out of mesh with the gear and remeshing it so that the flat face would be in the correct position with respect to the grinding wheel. This work-oscillating fixture operated very smoothly even at a high speed, due to the harmonic motion imparted to the work by the connecting-rod. This caused the rotary speed of the work to be gradually diminished toward the end of each stroke and accelerated again after the reversal of the direction of rotation.

Stock parts used in the product manufactured by the plant where the work was done were used in the set-up shown in Fig. 3. Only about two hours was required to assemble these parts ready for operation. After the round portion of the work was ground as described, the straight sides forming a point on the locating plug were finished on a surface grinder. The piece was pressed in a hole reamed in the side of a cast-iron, box-shaped fixture like the one shown in Fig. 2, with one flat side in a horizontal position. After grinding one side, the fixture was turned over so that the other side could be ground at an angle of 90 degrees with the first one.

BORING CONCENTRIC SLOTS

By PHILIP F. SHAFRAN

During a considerable number of years of varied machine shop experience, the most interesting lathe operation the writer has ever witnessed was the machining of concentric slots in the part *A*, Fig. 2, of the form shown at *S* in the cross-section *X–X*, Fig. 1. These slots extend through the entire length of the part *A* except, of course, the 1/2-inch recess shown on each end, so that the length of the slots is 7 inches. The only machine available for this job was an engine lathe.

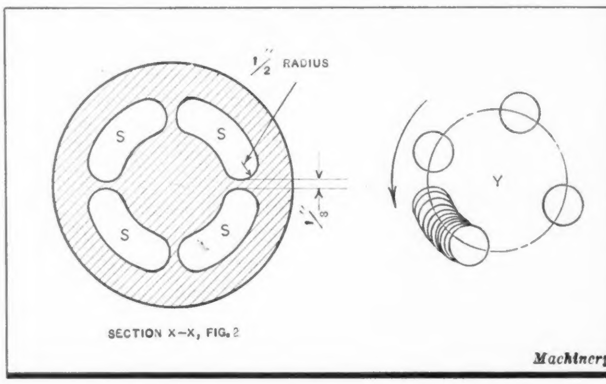


Fig. 1. Cross-section showing Finished Concentric Slots

Cast-iron supports *B* and *C*, Fig. 2, were clamped to the carriage of the lathe and holes drilled and bored in these supports to fit the shafts at each end of part *A*. Support *C* was then set over so that a 3/4-inch hole *D* could be drilled and reamed with tools held in the lathe spindle, after which support *B* was set over and the hole *E* drilled and bored to a diameter of 63/64 inch to correspond with the one drilled in support *C*. Two holes were next drilled and tapped to receive the set-screws *F*. Tongues were also added to supports *B* and *C* to fit the T-slots of the lathe carriage.

The entire fixture, with part *A* in place, was set up as shown in Fig. 2. Four equally spaced holes, one of which is shown at *G*, were drilled, as shown in the end view of the illustration. One of the holes *H* is shown as having already been extended to form a concentric slot. A drill about 16 inches long was used in drilling the four evenly spaced holes through part *A*, the hole *E* in the support *B* being used as a guide for the drill. The set-screws *F* served to prevent part *A* from moving during the drilling process. After drilling one of the holes, set-screws *F* were loosened and the part turned one-fourth of a revolution for drilling the next hole. When the four holes had been drilled in each part, the support *B* was removed, the drill replaced by a boring-bar *J*, and support *B* again reset, while part *C* remained in the same position.

The next operation was to extend the four holes to form four concentric slots like the one shown at *H*. Boring-bar *J* was used for this job. This bar was about 30 inches long and 3/4 inch in diameter for a length of 19 inches, while the remaining length was turned to a diameter of only 63/64 inch. By making the larger diameter of the boring-bar 1/64 inch under the size of the finished slot, sufficient space was obtained between the bar and the slot to provide for chip clearance.

A tool bit *K* was inserted in the bar as shown. The boring-bar *J* was set between the centers of the lathe and supported by holes *D* and *E* in the parts *C* and *B*, so that the boring-bar thus extended through one of the 63/64-inch holes already drilled. The tool bit *K* was then adjusted to bore a hole 1 inch in diameter. The carriage was fed past the tool *K* for the full length of the work, after which it was

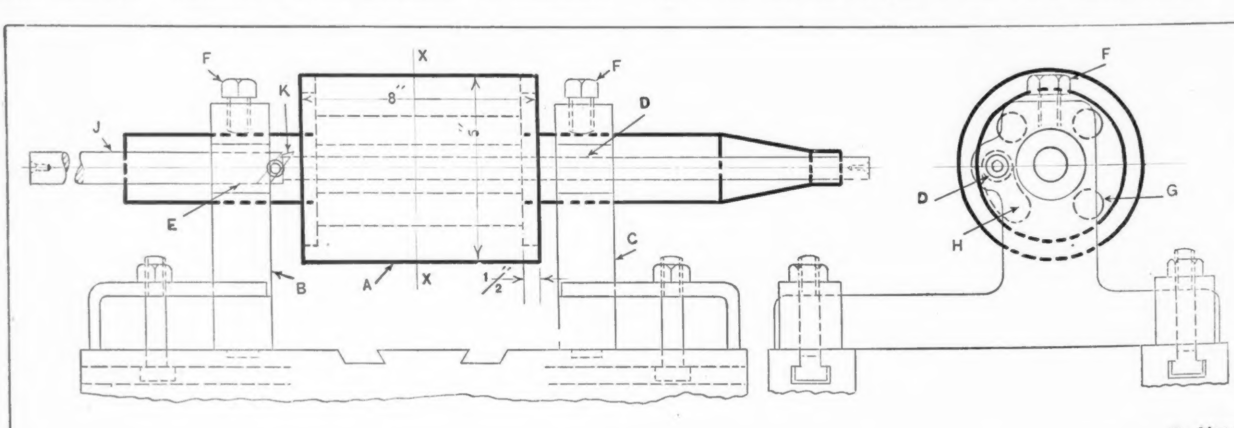


Fig. 2. Lathe Set-up used in boring Concentric Slots

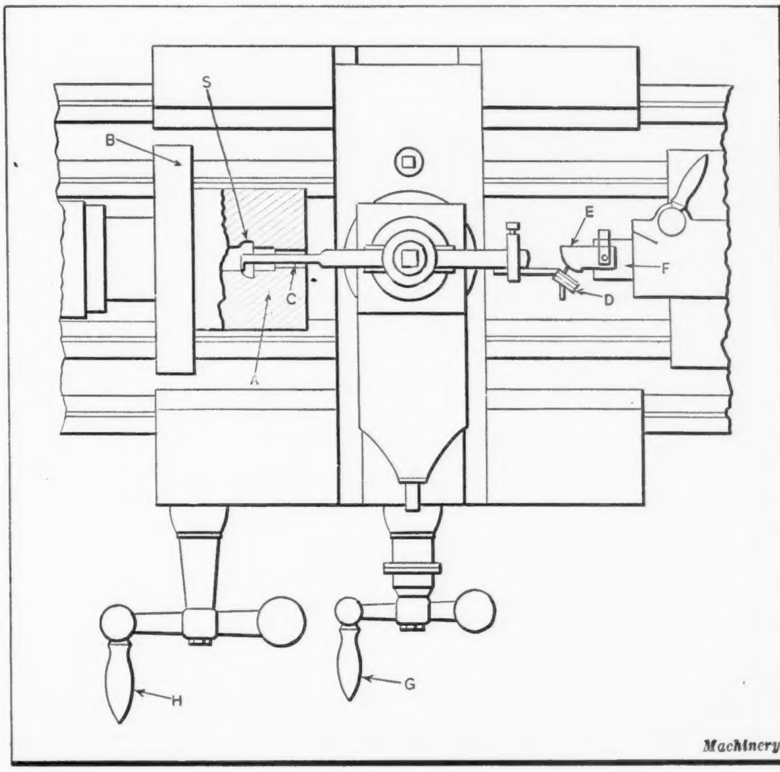
brought back to its original position. Next screws *F* were loosened and part *A* revolved until there was about 1/64 inch between the 3/4-inch boring-bar and the side of the 1-inch hole. The set-screws *F* were then retightened, and the machine again set in motion. This process was repeated until the slots extended to within 1/8 inch of the next hole. A graphic illustration of the development of the slot is shown at *Y*, Fig. 1. In this view the arrow shows the direction in which the part *A* was revolved in developing the slots.

After forming one of the slots, the tailstock and carriage were withdrawn so that the boring-bar *J*, Fig. 2, cleared the slot in order to permit part *A* to be indexed to the next hole. When the four slots had been completed, support *B* was removed to permit part *A* to be replaced by a new piece of work. The slots produced in this manner, while not perfectly smooth, were nevertheless satisfactory. Smoother slots could, of course, have been obtained by taking smaller cuts, but this was not considered necessary. A more practical method of making slots *S* could probably be devolved if the problem were given more consideration, but in view of the fact that there were only four parts to be made, the only available machine being an engine lathe, and the cost of the job was required to be kept low, the writer believes that the process described was as practical as any that could have been employed.

INTERNAL SPHERICAL TURNING

By MARTIN W. KOTAWBA

The most interesting lathe job that the writer has ever seen was performed in the shop of S. M. Ryder & Sons, Niagara Falls, N. Y. The job was that of turning the spherical surface shown at *S* in the accompanying illustration. The work *A* is a die used in the production of die-castings. It was made in two parts, the only opening being a gate for pouring the metal. The impossibility of milling the spherical surface without considerable expense led to the development of the method described and illustrated in this article.



Method of turning Internal Spherical Surface in a Die-casting Mold

The work *A* was secured to the faceplate *B* of a lathe for the spherical turning operation, which was the last machine work to be done on the die. The hole forming the gate in the die was trued up by the use of an indicator, and the turning tool *C* was set at the proper depth from the face of die *A*. An indicator *D* was fastened to the rear end of the tool *C*, and a templet *E* having the required radius was mounted on the tailstock spindle *F*. This templet was set square with the face of the tailstock, and the indicator *D* adjusted to read zero.

By operating the cross-feed handle *G* in combination with the carriage handwheel *H*, so that the indicator would read zero at all times, a spherical surface was produced in the die having a radius corresponding to that of the templet *E*. The accuracy of the spherical surface turned in this manner was held within limits of 0.003 inch, which was entirely satisfactory.

A DEEP-HOLE DRILLING JOB

By G. W. JAGER

The most interesting lathe job with which the writer has ever come in contact was the drilling of a 5/16-inch hole through a spindle 32 inches long. This hole was required to fit a piece of drill rod so that there would be no side play. The spindle was rough-turned to within 0.010 inch of the finished dimensions shown in Fig. 1. Then the tailstock was removed from the lathe, and one end of the spindle was gripped in the chuck. Two steadyrests were used to support the work, one being located midway between the end of the work and the chuck and the other at the outer end of the work.

A tool-holder made especially for the job was held in the toolpost of the lathe carriage. Two removable split bush-

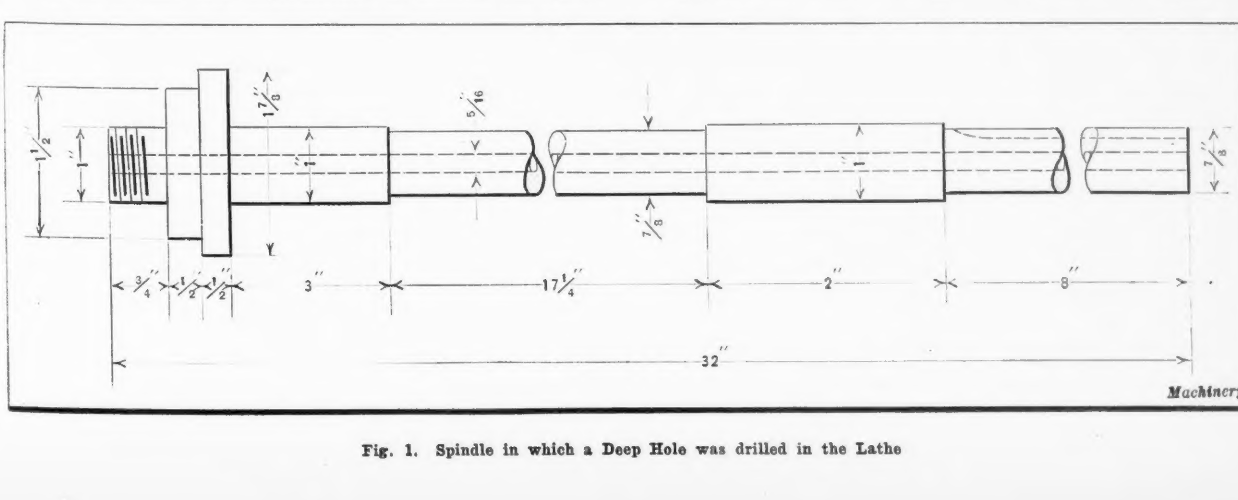


Fig. 1. Spindle in which a Deep Hole was drilled in the Lathe

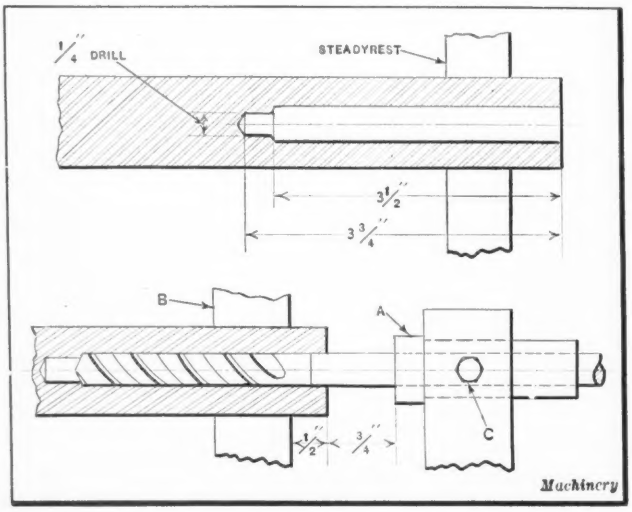


Fig. 2. Diagrams illustrating Methods used in drilling Spindle shown in Fig. 1

ings were provided for this holder. One bushing had a 1/4-inch hole, and the other, which is shown at *A*, Fig. 2, was machined to fit the shank of a 5/16-inch drill. A hole 1/4 inch in diameter by 3 3/4 inches deep was then drilled in the end of the work, the drill being held in the 1/4-inch bushing. The 1/4-inch hole was next bored out to a diameter of 5/16 inch with a specially forged boring tool. Finally, a 5/16-inch drill was clamped in the bushing *A*, as shown in the lower view, Fig. 2. This drill had a drill rod extension which permitted the work to be drilled to a depth of about 16 inches. While drilling the holes, the work was supported by the steadyrest *B* and the drill fed in until the end of bushing *A* was nearly in contact with the work. The set-screw *C* was then loosened to release the drill from the bushing, and the lathe carriage moved back about 3/4 inch, after which the set-screw *C* was tightened and the drill fed in as before. This operation was repeated until the hole had been drilled to a depth of about 16 inches as previously mentioned.

The hole through the work was completed by turning the work end for end between centers and drilling from the opposite end in the manner just described. Before starting the second drilling operation, the work was, of course, trued up by the aid of an indicator. A new 5/16-inch drill was used for the second operation so that the size of the hole at each end of the work would not be affected by wear of the drill.

Two spindles were drilled by the method described, and in each case the 5/16-inch diameter drill rod was found to be a nice, smooth sliding fit in the holes. It was possible, however, to locate the point where the two holes met with a rod somewhat smaller than the diameter of the drilled hole. In order to do this, the end of the rod had to be carefully squared up and considerable care taken in feeling for the joint. The spindles were turned and ground between centers after being drilled. For these operations, false center plugs were inserted in each end of the spindles so that they could be mounted between centers.

WINDING A 300-FOOT COIL SPRING

By HENRY J. APPEL

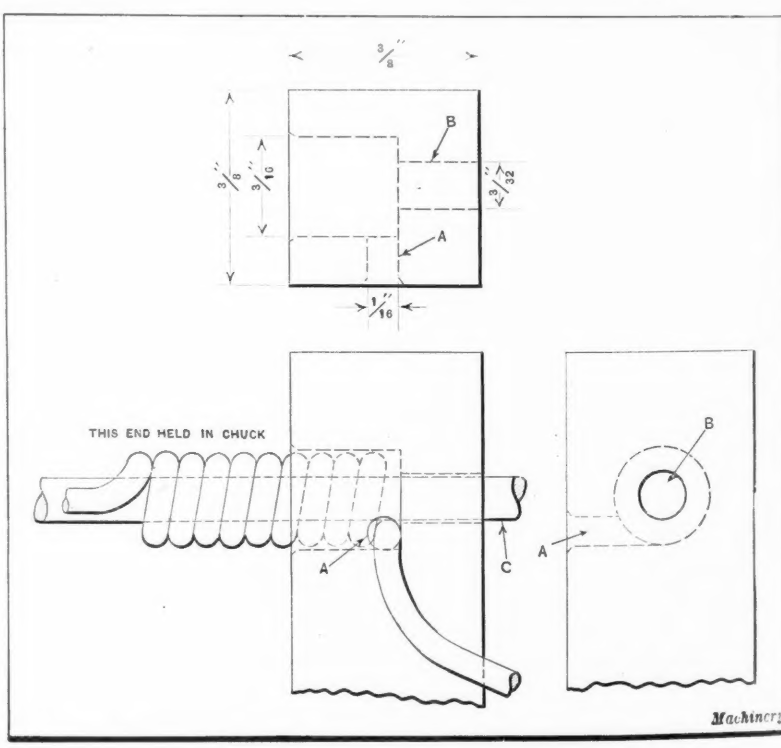
The method of winding close-coiled springs described in this article was employed in filling a rush order for 5000 feet of springs, to be used as conveyor belts on newspaper conveyors. The outside diameter of the springs was 3/16 inch, and they were made in 300-foot lengths from No. 22 steel piano wire which had a diameter of 0.049 inch. A winding tool was made by drilling a 3/32-inch hole *B*, as shown in the accompanying illustration, through one end of a piece of 3/8-inch square tool steel about 8 inches long. This hole was counterbored to a depth of 1/4 inch with a 3/16-inch drill, and the bottom of the counterbored hole squared up. A 1/16-inch hole *A* was next drilled through one side of the piece so that it would just touch the bottom and one side of the counterbore in hole *B*. This end of the tool was tempered and a file handle fitted to the other end.

A piece of No. 30 piano wire *C* (0.080 inch in diameter), about 40 inches long, was used for the arbor which was first straightened by pulling it through a revolving "bent tube" held in the lathe chuck. The wire used for the coil spring was mounted on a reel near the lathe. One end of the wire was threaded through the hole *A* and out through the counterbore as shown. The arbor was then passed through hole *B* and both the arbor and wire clamped in a three-jaw chuck. The other end of the arbor was allowed to revolve inside the tailstock, the center having been removed.

The winding tool was held in the hand, and after the lathe spindle had made a few revolutions, the chuck was released and tightened again on the outside of the coils. This process was repeated until the full length of the arbor had been wound with the piano wire. The lathe spindle was then stopped, the arbor drawn back to its original position, and the chuck tightened again. This operation was repeated and the springs cut off when they were about 300 feet long. The spring, as it came from the spindle, was allowed to turn inside pipes laid on the floor. The wire was lubricated by tying a piece of oil-soaked waste around it between the reel and the winding tool. A spindle speed of about 800 revolutions per minute was used in winding the springs. With this arrangement, the average output was about 150 feet of coil spring per hour.

* * *

Recently published statistics show that at the present time there are 19,600 passenger automobiles in use in Holland. In addition there are 14,000 commercial trucks, 31,500 motorcycles and 1,000,000 bicycles in use. Of the automobiles, 40 per cent are imported from France, the United States taking second place as a source of supply.



Tool for winding Coil Springs in the Lathe

CARD RECORD SYSTEM FOR TOOL DEPARTMENT

By WILLIAM H. KELLOGG

One of the advantages gained by having a tool record system such as the one described in this article is that it provides a reliable means of identifying each tool with the job for which it was designed, so that it will not be used in performing operations for which it is not intended. The system also helps the tool planning engineer to proceed in

SHOP OPERATION RECORD	PART NO. M31
NAME OF PART Eccentric	
MACHINE Type K Washing Machine	
NO. OF OPERATION 1 Face and bore	
2 Turn eccentric	
3 Face hub	
4 Drill	
5 Tap	
6 Enamel	
7	

Fig. 1. Front Side of Shop Operation Card

a systematic manner when determining the kind of tools required and the proper sequence of operations.

The card record system, as originally developed, was the first step in providing special tool equipment for several machines manufactured by a certain company. The parts for these machines had previously been machined with regular tool equipment, but the cost of the machines produced in this manner was excessive, and as the production was to be greatly increased, it became necessary to devise special tooling equipment. In order to benefit from the new tool equipment as soon as possible, plans were made to select the parts that were in the greatest need of new tools and build special equipment for these first.

The first work was to plan the arrangement of the cards for the tool record system. Only two cards were made—the shop operation card (the front and back of which are shown in Figs. 1 and 2, respectively) and the tool record card shown in Fig. 3. These cards proved of great assistance, from the planning of the tools for each part, the issuing of the shop order for the tools, and the work in the shop, to the final adoption of the tools as a regular part of the shop equipment. After the tools are completed, the cards serve as a means for quickly locating the drawings of any

TOOLS USED	TOOL NO.	OPERATION NUMBER
Special chuck	M31X	2
Caliper gage	M31Y	2
Locating gage	M31Y2	2
Arbor	M31X2	3
Drill jig	M31Z	4

Fig. 2. Back Side of Shop Operation Card

tool in case a duplicate is required, repairs are to be made, or the tool changed in some way. Usually it is possible to determine whether or not a tool can be used in the production of other parts by referring to the record cards.

The shop operation cards are arranged, or indexed, according to the part number of the piece, which is placed in the upper right-hand corner of the card, as shown in Fig. 1. The name of the piece and the machine to which it belongs is given at the top of the card, and following this is a list of all the operations that are performed on the piece. It is important that every operation performed on the part as a separate piece be recorded in this list, so that the data can be used in estimating the production cost.

The back of the shop operation card (see Fig. 2) bears the name and number of each tool, and the number of the corresponding operation. This record is compiled from the data on the face of the card, and is filled in after carefully determining what tools are to be used. The record on this card represents the best judgment of the chief tool designer or the production manager. If a change in the method of machining or producing any piece is made, this is at once recorded on the card. In cases where there are more operations than can be shown on one card, a second one may be used, a note being placed on the first card to call attention to the fact that there is a second card. The most convenient size for the cards is 3 by 5 inches.

In Fig. 3 is shown the tool record card, which is the same size as the shop operation card. This is indexed according to the tool number. The part number, the operation number, the name of the tool, and the tool drawing number are given on this card, so that it forms an index to the tool drawing files. A complete record of the progress in the production of the tool is given on the lower left-hand part of the card. At the right of each item is written the date on which each stage of the work is completed. It is also desirable to note by some convenient symbol or initial the shop to which the work was assigned. This is especially important if the work is done by an outside concern. The date on which the order for a change is given is recorded in the column

TOOL RECORD	PART NO. M31 OPERATION NO. 2	TOOL NUMBER M31X
NAME OF TOOL Eccentric chuck		TOOL DRAWING NUMBER X512
TOOL ORDER ENTERED 12/3/23	CHANGES ORDERED	
DRAWINGS COMPLETED 12/8/23	Mar. 3	X680
PATTERNS ORDERED 12/8/23		
MATERIALS ORDERED 12/11/23		
SHOP WORK BEGUN 12/18/23		
TOOL COMPLETED 12/27/23		
TOOL O.K. 1/2/24		

Fig. 3. Tool Record Card

headed "Changes Ordered." Any additional information regarding the tool may ordinarily be found by consulting the drawing, which in this case bears the number X512, as indicated near the upper right-hand corner of the card. However, changes in the original design made additional drawings necessary for this job. The number of the new drawing— X 680 —is given in the column "Changes Ordered."

* * *

The leading industry in Sweden today is forestry. The annual value of the products turned out by the Swedish saw mills exceeds $400,000,000, a value which, in proportion to population, would correspond to about $8,000,000,000 for the United States, if our per capita output of lumber were the same as Sweden's. The value of the output of the Swedish saw mills is steadily increasing from year to year, because of constant efforts to introduce less wasteful processes of production. Until a short time ago, the United States was a strong competitor of Sweden in the Mediterranean lumber trade, but the reckless cutting of timber in this country, without replanting, has rapidly exhausted the supply available for export, and the Mediterranean market is now practically in the hands of Swedish lumber dealers. Great interest in reforestation has recently been developed in the United States, but it is estimated that it will take nearly a century before American timber exportation will once more become a factor in the world's markets.

Designing Automatic Machines

Procedure in Design, and Use of Simple Models for Analyzing the Problems Met With

By ALBERT A. DOWD

SOME of the most difficult problems encountered by the designer of automatic machines are those dealing with the feeding of different articles through some form of hopper, and arranging them in such a position that they can be handled in a uniform manner. To mention and illustrate all of the ingenious schemes used for this purpose in various types of automatic machinery is obviously out of the question, but certain principles are frequently used and the writer will endeavor to describe a number of these and show how they are applied.

Assume that an automatic machine is to be designed for wrapping the small cylindrical piece *A* shown in Fig. 1. The length of this piece is a trifle greater than the diameter. The pieces are to be placed as shown at *B*, three at a time, on a wrapper of the form shown by the dotted lines *C*. This piece is to be wrapped around the units as illustrated at *D*, and the ends tucked in at *E* and *F*. The problem involves feeding the pieces from a hopper or other container and arranging them end to end as at *B*, ready to be wrapped.

Procedure in Analyzing Problem

First consider the shape of the pieces and the fact that they must be arranged end to end, when they come through the machine. Shall we dump them into a hopper or try some other method? As the pieces are only slightly longer than their diameter and as they are cylindrical, there is little chance for them to wedge if dumped into a hopper. They would also roll or slide down an inclined plane if the angle were steep enough. They could be fed along a trough with a worm conveyor or some similar arrangement. In fact, there are a great number of methods that could be used to produce results. The problem is to devise a scheme that will be effective in operation and one least likely to give trouble. The writer has found it of great assistance, in solving a problem of this kind, to have at hand a number

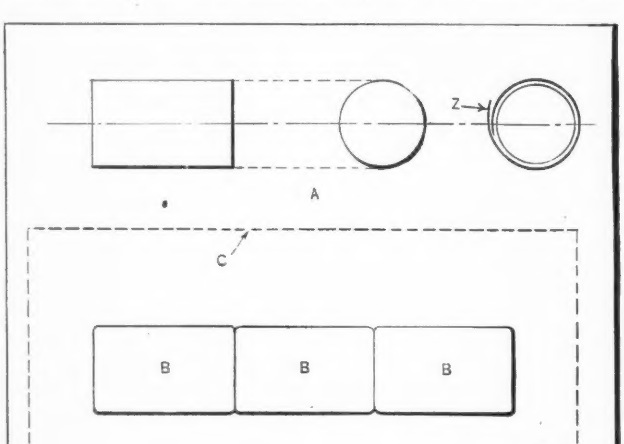


Fig. 1. Example of Product to be packed and wrapped automatically

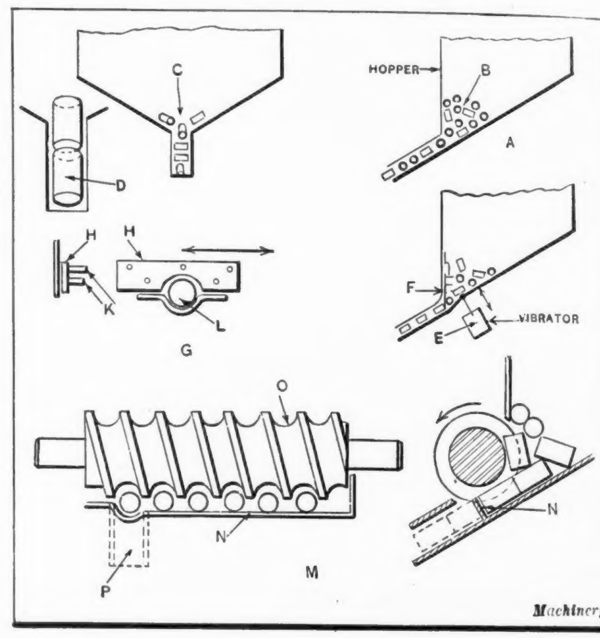


Fig. 2. Several Different Methods of handling Work A, Fig. 1

of sheets of heavy cardboard with hard or glazed surfaces, in order to facilitate experimenting before the actual design is started. A few cylindrical paper cartons or mailing tubes of different diameters, gummed paper, sheet tin or zinc, wooden dowels of several diameters, a jar of paste, and a pair of tinsmith's shears will be found convenient.

Let us follow through some of the steps taken in the analysis of this piece. We start with the knowledge that the pieces will roll or slide, and if they are spread on an inclined plane they may do either, according to the angle of inclination of the plane. If too steep, they may slide when we want them to roll or even tumble over each other, so that they will come to the bottom of the slide in all kinds of positions. As a preliminary experiment, take a handful of pieces and a sheet of cardboard and set the latter up at a slight angle, allowing the pieces to roll or slide down it several times and noting how they reach the table. If the angle is very slight, those that are in the right positions will roll downward, while the others will remain stationary.

By changing the position of the cardboard, an angle can soon be found which will allow the pieces both to roll and to slide, but they will come out at the bottom in all sorts of positions. To avoid this, we can paste two or three angular pieces of cardboard on the surface of the large sheet, leaving openings just large enough between them to allow the diameter of the piece to pass through. This experiment will show that while some pieces will pass through the baffle plates, others are likely to lodge and stop the exit. By tapping the under side of the cardboard with the fingernail rapidly, a vibration can be set up which tends to disturb and change the arrangement of the pieces continually, and a great many of them will pass through as desired. We could continue to experiment along this line, eventually developing an arrangement of plates which would cause the pieces to fall through and enter a chute in a uniform manner. It would be necessary to use a vibrator to prevent lodgment of the pieces, and there would always be a pos-

sibility of some pieces failing to go through the baffles and stopping the whole mechanism.

As another experiment suppose we build a little hopper out of cardboard, as shown at A in Fig. 2, dumping a handful of pieces into it, as shown at B. If the outlet of the hopper were wide, the pieces would come through as at C, but if narrowed to but slightly larger than the diameter of the pieces, they could come only as shown at D in the enlarged view. So we still have an uncertain element, although it might be possible to use a vibrator as at E, combined with an oscillating valve having projecting pins F which would break up and loosen any pieces lodging around the chute opening. In the enlarged view G, the plate H oscillates in the direction of the arrow, breaking up any fixed arrangement of pieces by means of the protruding pins K, and leaving the opening to the chute clear intermittently, so pieces L can pass through. Even this arrangement is rather unsatisfactory, although used occasionally,

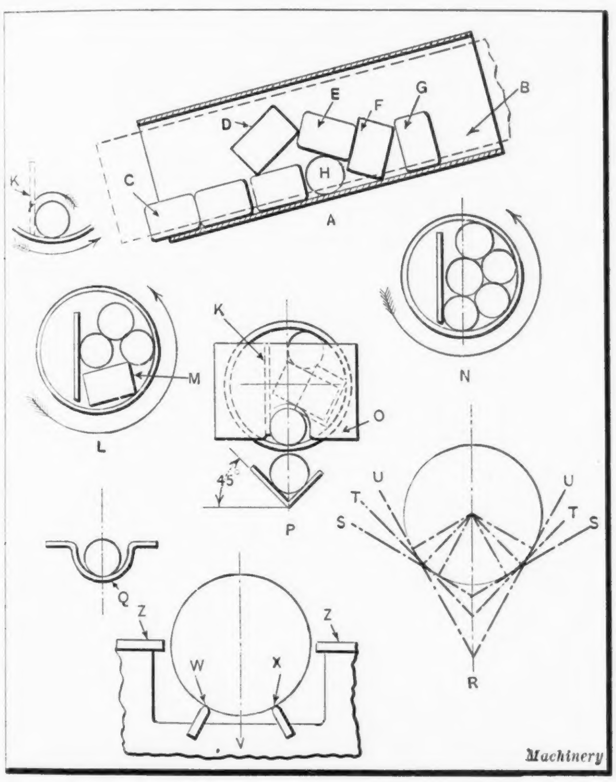


Fig. 3. Steps in developing Method of feeding Work A, Fig. 1

as there is always danger that the pieces will not feed rapidly enough to keep the machine supplied.

So far we have been depending upon gravity and oscillation of the pieces to feed them to a chute, but it is desirable to develop a positive method that will act without fail under all conditions. Whenever possible, a scheme should be used which is not entirely dependent on gravity. In the example suggested, at M in the lower part of the same illustration a special form of worm is employed. In the light of the experience gained by the previous experiments, it would appear that something of this sort might be used in connection with a hopper or inclined surfaces with baffle plates. Some arrangement similar to the oscillating plate with pins could be used to disturb the pieces, which would drop down between guides into one end of box N, where they would be picked up one at a time by the worm O and carried along to the chute P, down which they would slide one after another, end to end. Some experimenting would be necessary to develop the best form of oscillating valve. The speed of oscillation, as well as the number of revolutions per minute of the worm, should be adjustable. It is impossible to give fixed rules for determining these things because so many factors enter into the design, any one of which may affect the speed or form of the oscillator. The use of a simple model is the only safe way of solving these problems.

To illustrate this point, one can easily understand that if pieces of the shape shown were somewhat rough instead of being smooth, they would tend to lodge more easily and would not slip readily on an inclined surface that would be steep enough for the smooth pieces. Also if the pieces were soft, or easily broken, or sticky (like candy), a different treatment would be necessary. None of these matters should be treated lightly, for success often depends upon patient attention to such details. A piece of work will move sluggishly down a chute made of copper or zinc, but will move rapidly down another made of steel, set at the same angle. The writer has seen a model chute made of zinc (because it was easy to work) set at a steep angle to allow the pieces to slide rapidly, which, when made of steel for the finished machine, gave the pieces so great a speed that they rebounded at the lower end. To remedy this, it was necessary to pass each piece through a flexible "cowl" which served as a brake to slow it up. It is better to keep these points

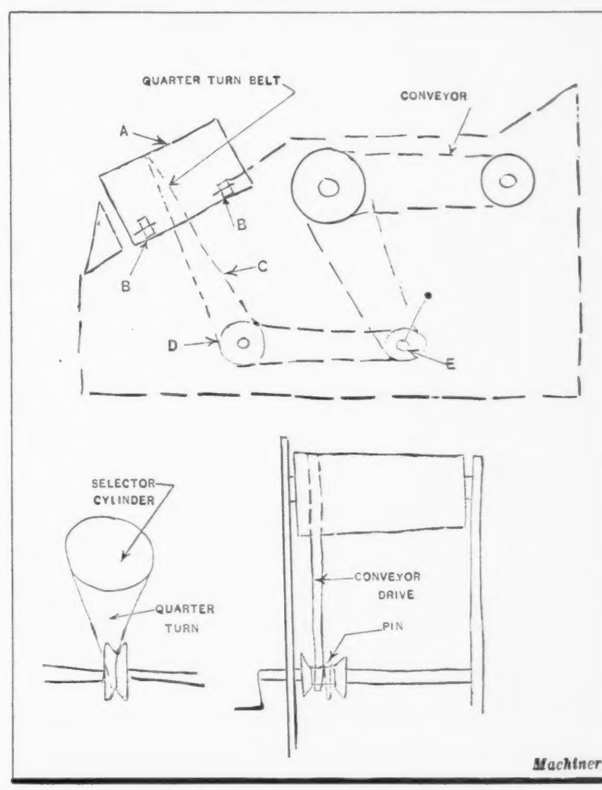


Fig. 4. Rough Sketch showing Details of Drive for Conveyor

in mind during the experimental stage of the work, so as to avoid complications in the finished machine.

Designing the Model

The first step in designing a model for feeding parts like the one shown at A, Fig. 1, is to obtain a cylindrical carton A, Fig. 3. If we hold this at a slight angle and drop a handful of pieces into it at B, they will roll downward and many of them will come out at C as desired. Some, however, may take positions shown at D, E, F, G, or H, and these, of course, will not pass through properly. By revolving the carton slowly, a noticeable improvement will be found, but even then some pieces will come through rolling as at H. If we continue to revolve the carton and hold a piece of pasteboard K parallel to the center line and a little at one side, as shown in the end view, the pieces will arrange themselves with their own axes parallel to the axis of rotation of the carton, and will feed through one after the other regularly, although occasionally two will come through at the same time one above the other. It is practically impossible with this kind of scheme to obtain an arrangement such as is shown in the end view at L where one of the pieces M has its axis at right angles to that of the carton. The pieces will almost invariably lie as shown in the diagram at N. To guard against any piece coming through the

tube crosswise, a piece of pasteboard is cut to the form shown at *O*. Now if the guard piece *O* with the piece *K* attached to it is held stationary and the carton revolved slowly while the pieces are fed into the upper end we will find that this is the most reliable of all methods so far tried.

As the work comes out through the hole in the guard plate *O* it must be led by a chute to the portion of the machine where the wrapping device is to be situated. It would appear that almost any kind of chute would be satisfactory, and under some conditions this is true. It is just as well, however, to consider, for a moment, the effect of the shape of the chute on the progress of the work. The natural way to make it is as shown at *P*, where the sides are at an angle of 45 degrees with the base line. The form shown at *Q* can also be used, and either of these may be satisfactory when the pieces are hard and smooth so that they slide easily. At *Q*, the arc of contact is theoretically a line, but as the difference between the diameter of the chute and work is not great, there is quite a large friction surface. In the diagram at *R*, the dotted lines represent chutes having sides set at various angles, the one at *S* having an included angle of 120 degrees, *T* 90 degrees, and *U* 60 degrees. The friction is probably the least in the first of these, because it has the least wedging action. It is often an advantage to make up several forms having different angles, and select the form that proves most suitable. Pieces having a shape that tends to make them wedge in a V-shaped chute can often be handled in a slide such as indicated at *V*. With a chute of this form, a point contact is obtained at *W* and *X*, which produces a minimum amount of friction, so that the pieces slide easily. If necessary, guard plates may be applied at *Z* to prevent side movement. The designer must, of course, consider the cost, and use the cheaper forms of construction when possible.

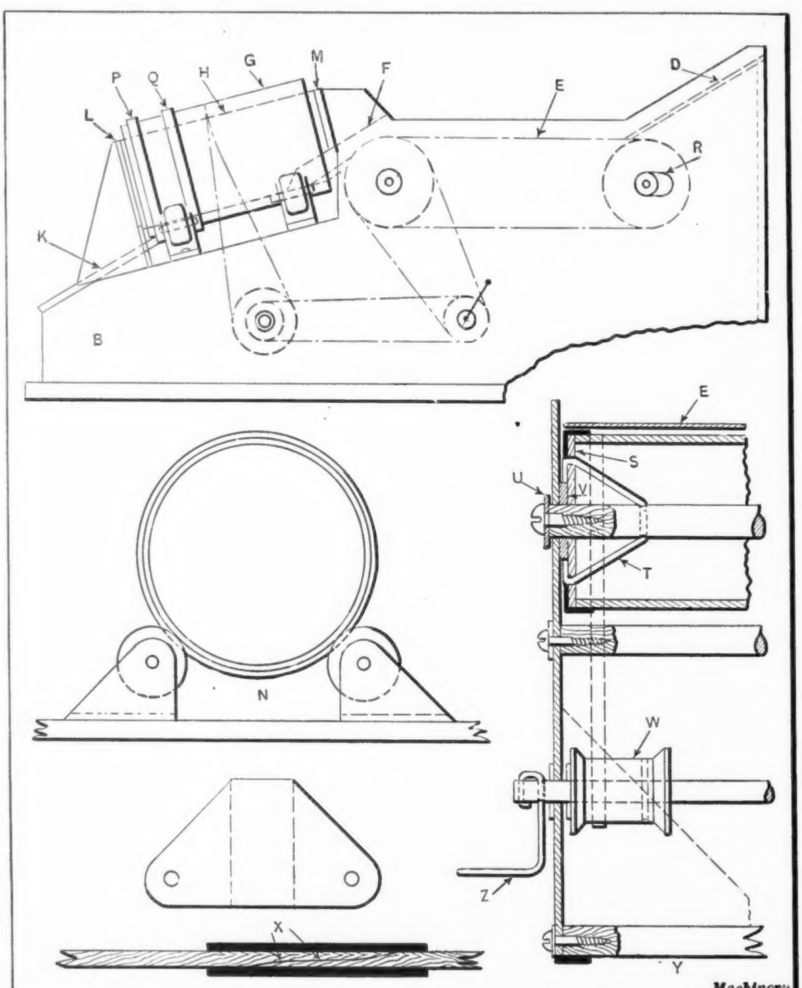


Fig. 5. Working Model of Feeding Unit for handling Work A, Fig. 1

Making Experimental Models

We have reached a point where the value of simple models can be readily appreciated, yet there are few designers who make such things themselves. They usually call upon a patternmaker or tinsmith to do the work. It is really surprising how much can be done with the materials mentioned previously, and it therefore seems a good idea to illustrate methods that the writer has found useful in this line of work. Nearly anyone can make up a pasteboard model which will look all right until an attempt is made to operate it, at which time it is likely to be found flexible, wobbly, and generally unsatisfactory. In the first place, the cardboard used should be heavy; seldom less than 1/8 inch thick even for small models. Corners should generally be pasted both inside and out, and reinforced with gummed tape on both sides. If open work construction is necessary, cross-braces or corner gussets are usually required for stiffness. After a model is made, it should work at least sufficiently well to demonstrate the idea. The writer has sold more than one automatic machine by demonstrating the practicability of some doubtful portion of it to the prospective customer by means of a model which cost only a few dollars to build. In addition to this advantage, it is always a source of satisfaction to work out an idea in this way in order to settle any doubtful point. Sometimes the pieces to be handled are of large size and would necessitate models of corresponding proportions, but in the majority of cases the work is small, so that small models can be used. If a problem involves large and awkward pieces, having considerable weight, it may be necessary at times to use a wooden framework for the model.

By following the general procedure here outlined, previous to building the model, fewer changes will be necessary. It remains only to proportion the units and put them together in the form desired. It is advisable first to make a freehand sketch like that shown in Fig. 4, in order to determine just how to apply the power. The sketch can be very rough and need only indicate enough of the scheme so that the model can be built in proper proportions.

Referring to the model shown in the sketch Fig. 4, the part *A* is a cylindrical shaped carton set on roller bearings *B* and driven by a quarter-turn belt *C* from a pulley *D*. This pulley is belted up from another on the shaft *E*, which turns and feeds the conveyor. The best way to make the model is to secure the cardboard to the drawing table and lay out the various parts according to scale measurements, the same as when making detail drawings, except that the dimensions are omitted. Then by using a sharp knife and a straightedge, the cardboard pieces can be cut out without difficulty, ready to put together. A little care in this work will pay for itself when putting the parts together.

The upper view in Fig. 5 is a side view of a completed model of the feeding mechanism shown in the rough sketch Fig. 4. Nearly all of this model is made from cardboard, and the side pieces *B* are cut from a single piece as shown. An inclined plane at *D* leads to the conveyor *E*, which carries the pieces over to the chute *F*; the chute enters the cylinder *G* at one side of the dividing strip *H*. The work comes out and drops into the chute at *K*. Cross-pieces of cardboard are placed at *L* and *M*, which serve the double

purpose of supporting the dividing strip and stiffening the framework. The piece L has a hole in it which allows only one piece at a time to pass through into the chute. The chute can most easily be made from a piece of tin bent to suit.

As we do not want anything inside the cylinder that will disturb the pieces or prevent them from arranging themselves easily, the carton is mounted on rollers, as shown in the enlarged detail at N. Bearings can be made by cutting out several forms of tin, as shown in the detail view, and bending these on the dotted lines. The rollers can be made of any cylindrical pieces that are handy, wooden dowels sawed off to the same length being convenient. By passing several thicknesses of gummed tape around the carton at P and Q, a guide ring is formed which prevents the cylinder from getting out of position.

The conveyor belt should never be made of paper but always of cloth. Paper is not good, because it is too stiff and does not cling to the rolls well. Also it is quickly affected by atmospheric changes so that it will not work at all. An automatic "take-up" can be easily provided by slotting the holes at R and using rubber bands to give the required tension. Belts can often be made from a section of automobile or bicycle inner tubes. They should be under very little tension to avoid excessive friction which would make the mechanism hard to operate. Rubber belt will not be found satisfactory when the revolving parts are heavy or unbalanced, as the belts will stretch and contract spasmodically, thus producing an irregular motion. Heavy soft cotton string with the ends overlapping each other at the joint X and made fast with several turns of electrician's tape, can often be used for belts. Pulleys wound with tape also have considerable pulling power.

A Few Hints Regarding Construction

If a model is to work smoothly, care must be taken in making the holes in the cardboard that serve as bearings for the shafts. A good way to make these holes is to take an old pair of bow dividers, heat one leg, flatten it out slightly and grind it to a keen edge on both sides like the knife in a washer cutter. Then shorten the other leg, leaving it a trifle longer than the knife-edged one, and grind it to a sharp point. With this tool a smooth round hole of any size within its capacity may be easily cut. The shafts can be tried in holes cut in a piece of waste cardboard when setting the tool, in order to obtain the desired fit. Whether the shaft is steel or wood, a little flake graphite or even lead from a soft lead pencil rubbed on the bearing surfaces will make the model work more smoothly. For best results, wooden shafts should be smoothed up carefully with fine sandpaper, and given a coat of graphite. Do not let the ends of any revolving member rub against any part of the frame, as this produces unnecessary friction. Washers should be used in places where revolving parts are likely to rub.

In making the conveyor rolls shown in the large sectional view at Y, Fig. 5, be sure that the rolls and axles turn together and do not revolve independently. By using a pasteboard disk S across the end of the carton which is fastened to it with strips of gummed paper, a wire bent as shown at T can be passed through the shaft and bent over against the face of the disk as shown, making a very substantial driver. With an iron washer at U and another at V, both graphited, a clean, smooth-working construction is easily obtained.

Discarded spools can often be used for pulleys, as shown at W, a groove being cut to keep the belt in position if necessary. Several methods of making a crank are possible, but that shown at Z is one of the best the writer has ever used. It is distressing to operate a model with a crank which twists and gets out of position. If the crank is made in the manner indicated at Z, with the end passing through a hole in the shaft and then bent over in a slot at the end and turned under, it will never become loose and cause trouble.

MOMENT OF INERTIA

By O. M. BURKHARDT
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The writer wishes to call attention to the fact that engineering students, and even engineers engaged in designing machinery, sometimes confuse the moment of inertia of a plane figure with that of a solid body. The polar moment of inertia J of a plain circular disk of diameter D is determined by the equation,

$$J = \frac{\pi}{32} D^4 \quad (1)$$

In nearly all text-books, the equation for determining the kinetic energy of a rotating body is expressed as follows:

$$E = \frac{1}{2} J\omega^2 \quad (2)$$

In this equation we have,
E = kinetic energy;
J = polar moment of inertia; and
ω = angular velocity.

Equation (2) is, of course, similar to the more familiar equation expressing the kinetic energy of all bodies having a translating motion which is written,

$$E = \frac{1}{2} mv^2 \quad (3)$$

where
m = mass = $W \div g$;
W = weight of body;
g = 32.16; and
v = velocity of body in feet per second.

It is obvious that, if v represents a circular motion, we may substitute $r\omega$ for v if we let r equal the radius of gyration and ω the angular velocity. Thus we have,

$$E = \frac{1}{2} mr^2\omega^2 \quad (4)$$

Equation (4) must, of course, be identical with Equation (2) or

$$\frac{1}{2} J\omega^2 = \frac{1}{2} mr^2\omega^2 \quad (5)$$

Simplifying (5) we have,

$$J = mr^2 \quad (6)$$

Obviously Equation (6) by no means expresses the same value as Equation (1). Equation (1) is for a plane figure, while Equation (6) is for a solid.

The mass of the rotating body for a disk of diameter D, thickness b and weight per cubic foot of material w is determined by the equation,

$$m = \frac{w}{g} = \frac{\pi}{4} \times \frac{D^2bw}{g} \quad (7)$$

Now the radius of gyration r for a disk is expressed by the equation,

$$r^2 = \frac{D^2}{8}$$

Substituting equivalent values in Equation (6), we have:

$$J = \frac{\pi}{4} \times \frac{D^2bw}{g} \times \frac{D^2}{8}$$

Simplifying,

$$J = \frac{bw}{g} \times \frac{\pi}{32} D^4$$

Hence for a solid body:

$$E = \frac{1}{2} \times \frac{bw}{g} \times \frac{\pi}{32} D^4 \times \omega^2$$

* * *

The production of natural abrasive materials in the United States in 1923 amounted to 250,000 tons, valued at more than $4,000,000. The production of artificial abrasives was 80,000 tons, valued at $9,000,000.

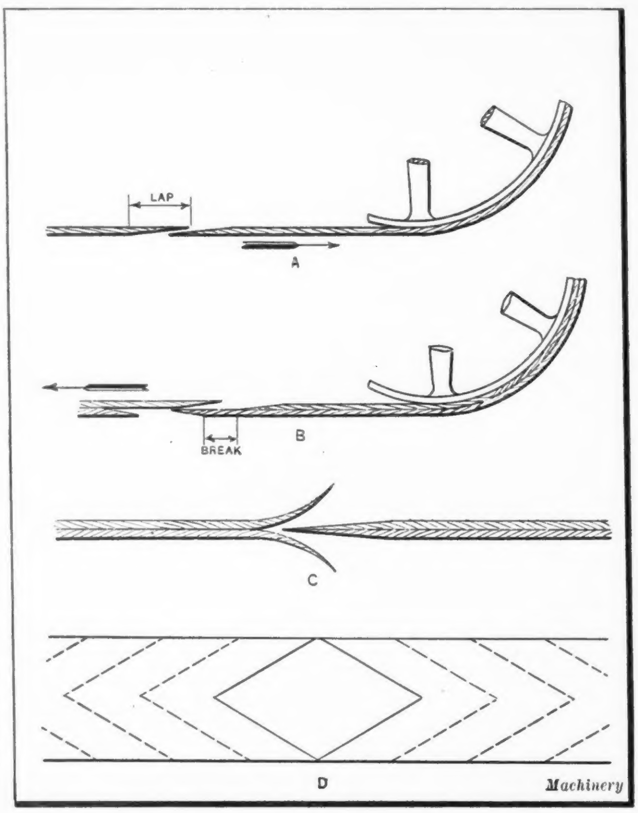
Joints of Endless Belts

By GUSTAVE A. FRENKEL

LEATHER belts usually are made endless by overlapping the wedge-shaped ends and cementing them together with belt cement, which consists of a mixture of hide glue and fish glue, boiled with pure tannin. The method of overlapping depends upon the size of the belt, whether single, double, triple, or quadruple. The single-belt lap is shown at *A* in the accompanying illustration. Both ends must be square with the sides of the belt and the beveled sections are given a fine feather edge.

The length of lap for single belts is: 6 inches for belt widths up to 5 inches; 8 inches for widths from 6 to 8 inches; 12 inches for widths from 9 to 11 inches; and 14 inches for widths from 12 to 14 inches. The skived-down ends of the new lap must follow the same direction as the other laps of the belt, which should run with laps pointing as shown at *A*. A single belt is always put on with its smooth or hair side next to the pulley, the rough or flesh side being outside.

Belt cement hardens more quickly than ordinary glue, and for this reason it should be kept hot and the cementing should be done in a mild temperature. The cement should be applied very thin by means of a brush, the surfaces being placed together immediately afterward and before the cement has time to cool. Pressing and rubbing down the joint serves to expel the air between the two surfaces, and it should be well done, particularly at the edges and the ends of the lap. Afterward the lap should be hammered evenly all over until the cement has set. If the cement chills before setting, it will have no binding power. In cold weather it will be necessary to warm the surfaces of the lap and also the board on which the ends of the lap rest between the clamps and rods.



(A) Lap for Single Belt; (B) Lap for Double Belt; (C) Tongue-and-fork Lap for Double Belt; (D) Diamond Lap for Rubber Belt

A commonly used lap for double leather belts is shown at *B*. The break varies according to the width of belt, and may be made as follows: 6 inches for belt widths up to 6 inches; 8 to 12 inches for widths from 6 to 18 inches; 18 inches for widths from 20 to 24 inches; and 24 inches for widths over 24 inches. Double belts must run with the laps pointing as shown at *B*; it is immaterial which side is put next to the pulley. The short or wedge-shaped lap next to the pulley should be cemented first, the work being done in the same manner as described for single belts. As this short part of the lap is only 4 to 6 inches long, it can be cemented and finished in one operation. The long part of the lap on the outside—for double belts up to 6 inches in width—can also be cemented and finished in one operation. For double belts over 6 inches wide, the length of the outer lap is too great to permit cementing at one time. Therefore, only a few inches should be cemented at a time, rubbing and hammering it down well, and continuing until the entire lap is finished. Although the lap shown at *B* is the best, sometimes the tongue-and-fork lap shown at *C* is used for double belts less than 12 inches wide, especially when the work must be done quickly or when the belt is cut from a roll and it is desirable to save leather.

Prior to using an endless belt, the cemented lap should be given time to dry before the clamps and rods are taken off. Under ordinary conditions the time required is from one-half to one and one-half hours. In very moist or warm rooms this time may well be extended to three or four hours. Rubber belts are usually made endless in the factory, as it requires a vulcanizing of the joint. The "diamond lap" mostly used is illustrated at *D*. This lap has proved to be far superior to any other lap and renders the belt of uniform strength throughout. The interwoven cotton belt is made endless by means of a splice, which leaves the belt of a uniform thickness, strength, and pliability. This splicing also has to be done in the factory.

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BRITTLENESS

Brittleness in metals is often confused either with hardness or with lack of ductility. In discussing this subject at a meeting recently held by the Birmingham Metallurgical Society, Birmingham, England, W. R. Barcley called attention to the fact that there is a definite need for a scientific definition of the term "brittleness." Often metals are considered brittle that, while they are able to stand a high maximum stress, have low elongation and reduction of area. This is an erroneous interpretation of the term. The property of brittleness is rather one that causes a material to break suddenly under a slight strain, like glass. Metals that break suddenly or abruptly under a high strain are not necessarily brittle.

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BOOKLET ON GEAR MEASUREMENTS

A pamphlet relating to gear measurements has been prepared by the National Physical Laboratory, Teddington, Middlesex, England, in which methods of gear measurements are explained in detail. For some time past the subject of gear measurements has been receiving attention at the National Physical Laboratory, and a special machine has been designed and constructed for this work. The methods employed in making measurements with this machine are such that the errors in the various elements of gear dimensions are determined separately, so that the cause of any unsatisfactory results in gear action can be generally traced to its source in the cutting process.

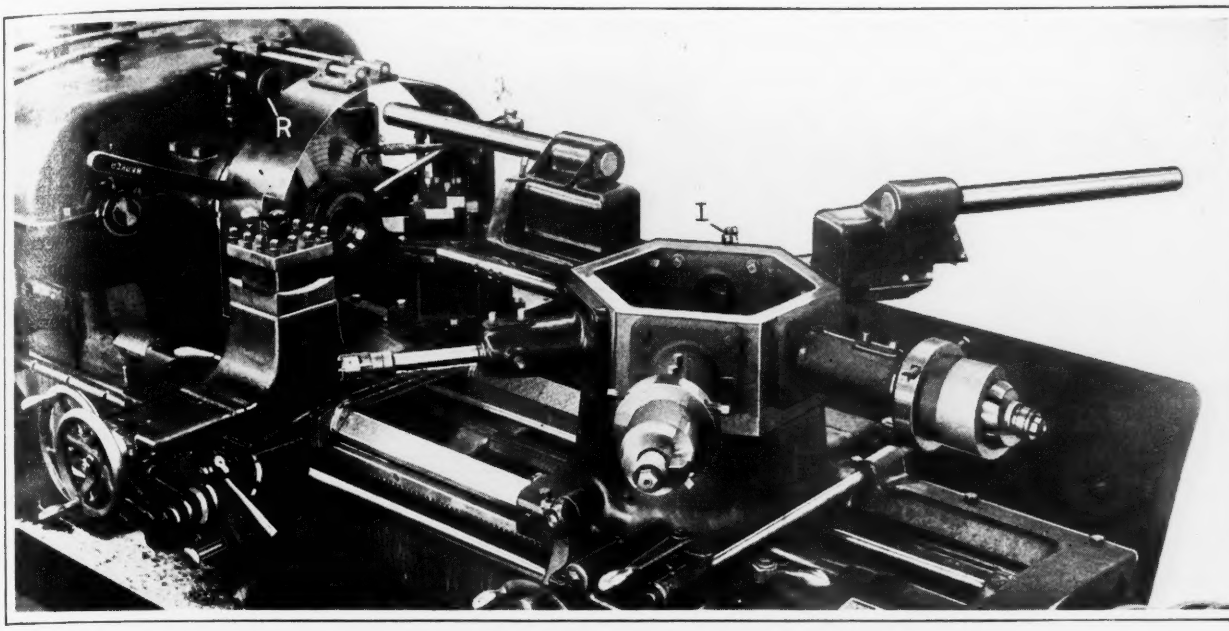


Fig. 1. Turret Lathe Set-up for machining Differential Housing shown in Fig. 2

Machining Differential Housings on a Universal Turret Lathe

By I. F. YEOMAN

DESIGNERS who realize the importance of making special provisions for resharpening and resetting tools used in turret lathe set-ups should find the special equipment described and illustrated in this article of more than passing interest. This equipment is shown complete in Fig. 1, set up on a 3-B Foster universal turret lathe ready for machining differential housings like that shown in Fig. 2. One of the finished housings is shown at the left-hand side of Fig. 3 and an unfinished one is shown at the right.

The castings are of malleable iron, and are chucked on the inside of the flange at *A*, Fig. 2, by a Foster-Barker chuck equipped with manufacturing type jaws. This chuck may be opened or closed while in operation so that the work can be released and removed while the spindle is coming to a standstill, thereby greatly speeding up the chucking operation, which requires a little less than six seconds. The first machining cuts taken on the work (second operation) were made with the tools held in the detachable block *B* on the rear cross-slide, as indicated in Fig. 5. These tools are entirely separate from those on the turret and take the roughing cuts on the surfaces *C*, *D*, *E*, *F*, and *P*, Fig. 2. The gage used in setting these tools is shown in Fig. 6.

After the rough-facing operations have been performed, the hole *G* and the counterbore *H*, Fig. 2, are roughed out with the tools held in the piloted boring-bar *I*, Figs. 1 and 5. This boring-bar is mounted on the turret, and the pilot end is guided by a bushing located in the body of the chuck. In the succeeding or fourth operation, the tools in boring-bar *J*, Fig. 5, finish-bore the hole and counterbore that were rough-bored by the tools in boring-bar *I*. At the same time that the finish-boring operation is being performed, the tool *K* in holder *L* takes a finishing cut over the surface at *M*, Fig. 2, which was rough-turned in the second operation by the tool *N*, Fig. 5. The tool *O* also takes a second finishing cut at *P*, Fig. 2. The toolholder *L*, Fig. 5, is piloted by an overhead bar *Q* which enters the bushing *R*, Fig. 1.

In the fifth operation, the reamer *S*, Fig. 5, finishes the counterbore *H*, Fig. 2. The large spiral forming cutter *T*, Fig. 5, is used in the sixth operation for rough-forming the spherical seat *U*, Fig. 2. This form cutter is piloted in the 2-inch counterbore *H*, which was reamed in the preceding operation. The pilot *V*, Fig. 5, is the outer race of an enclosed type of ball bearing. The object in using a pilot of this type is to prevent the surface of the reamed hole from being roughed up or damaged in any way.

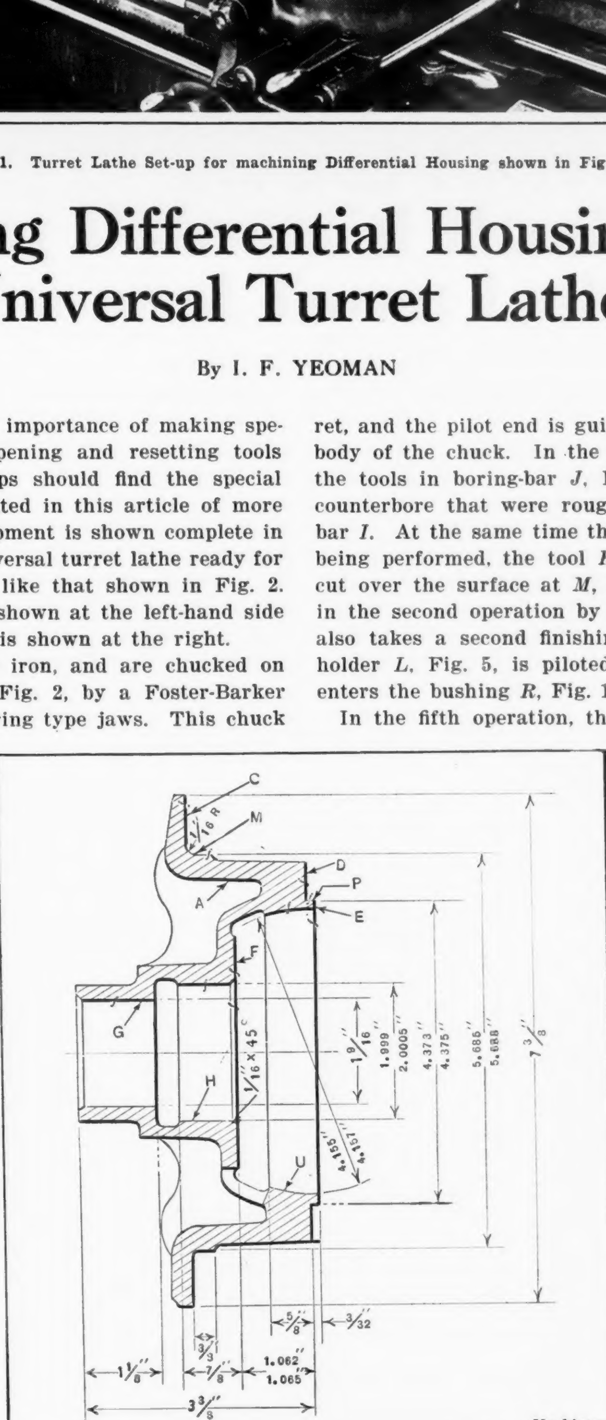


Fig. 2. Differential Housing machined with the Equipment shown in Fig. 1

The seventh operation is performed by the use of cutter *W*, Figs. 3 and 5, which is similar to the one shown at *T*. The details of this cutter may be seen to better advantage in Fig. 4, which also shows a section of the work in the machine. In this operation, the three surfaces *U*, *P*, and *D* are finished simultaneously and within the

limits specified in Fig. 2. The average production time, using the tool equipment described is 2½ minutes per piece. The pilot Z of the tool shown at W, Figs. 3 and 5 is the same as that employed on the tool T at V. Referring to Fig. 4, it will be noted that there is a groove at X. This groove clears lip P, Fig. 2, which is finish-turned in the eighth operation by an overhead piloted tool.

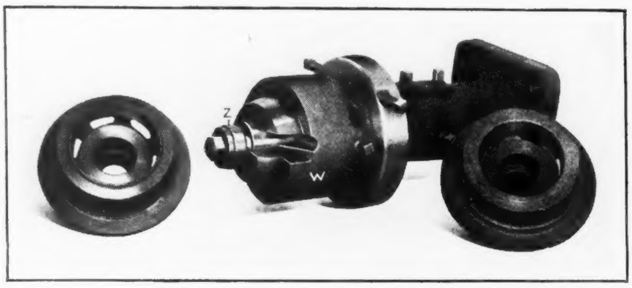


Fig. 3. (Center View) Spiral Type of Form Cutter; (Left-hand View) Finished Housing; (Right-hand View) Rough Casting

The large spiral-shaped forming cutters W and T, Fig. 5, are made of high-speed steel and are ground to finish di-

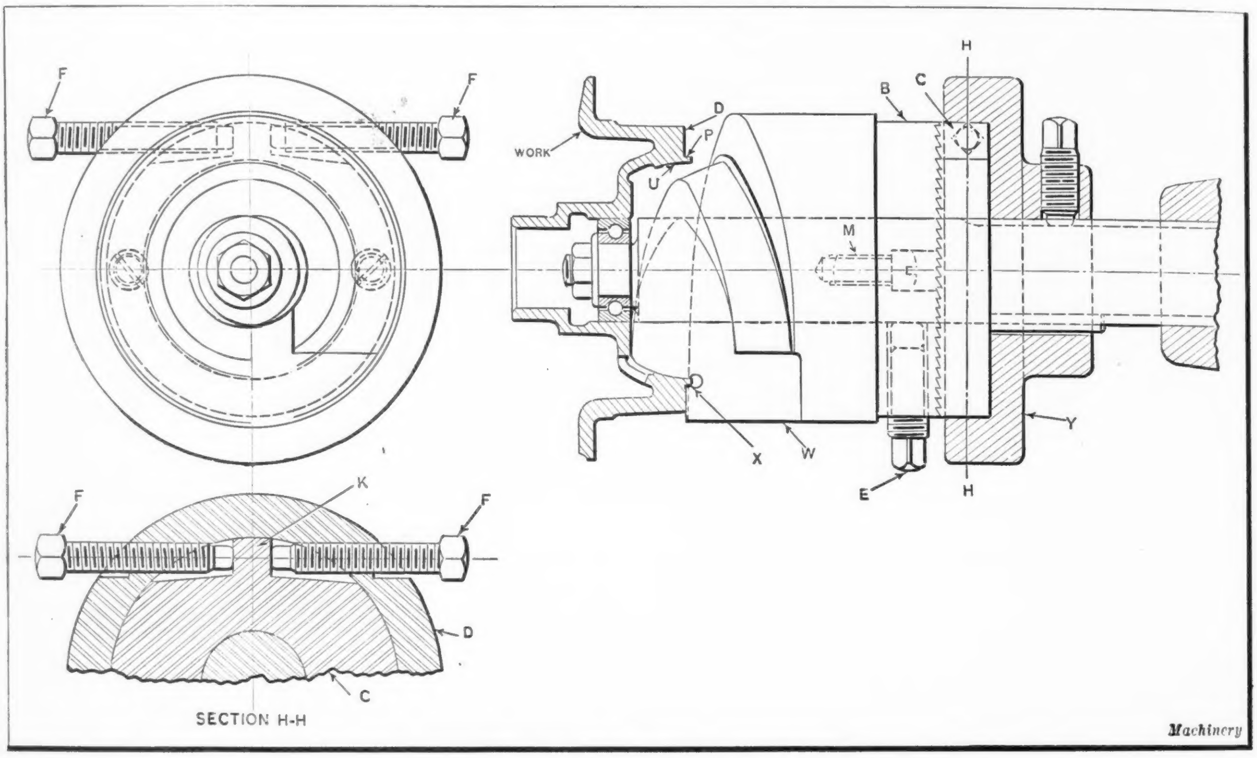


Fig. 4. Spiral Type of Form Cutter

mensions after being hardened. The circumference, or more strictly speaking, the length of the spiral forming portion of these cutters, is approximately 16 inches, and as the cutters are ground only on the face, it is obvious that they can be resharpened an indefinite number of times without changing the profile of the cutting surface. The central line of the spiral forming cutter is ⅛ inch above that of the pilot bushing, so that it is necessary to provide some means of obtaining close adjustment of the cutters after each grinding.

Referring to Fig. 4, it will be noticed that teeth are cut at the rear end of member B which fit corresponding teeth on the disk C in holder Y. It will also be noted in section H-H that part C is provided with a lug K. The two set-screws F that bear against lug K can be adjusted so that the forming cutter will be rotated on the tool-spindle a limited amount. When this adjustment is not sufficient to bring the cutting face into the proper position, the teeth in member B are disengaged from those in part C and are reengaged in a position that will bring the cutting face into approximately the correct position, the final adjustment being made by set-screws F.

The members B and C, which are fitted together with the notched ratchet teeth, are made of mild steel. The member B is secured to the forming cutter by machine screws, one of which is shown at M. The member C is ground to a close running fit on the pilot bar; and the cutter W is also made a close fit on the pilot bar. The screw E serves to lock the cutter in place and prevent any outward movement, but it does not assume any of the torque caused by the cutting action. The gage shown in the lower view of Fig. 7 is used in setting the forming cutter W, Fig. 4, in the correct position after it has been reground. When making the final setting, the screw E is tightened slightly and

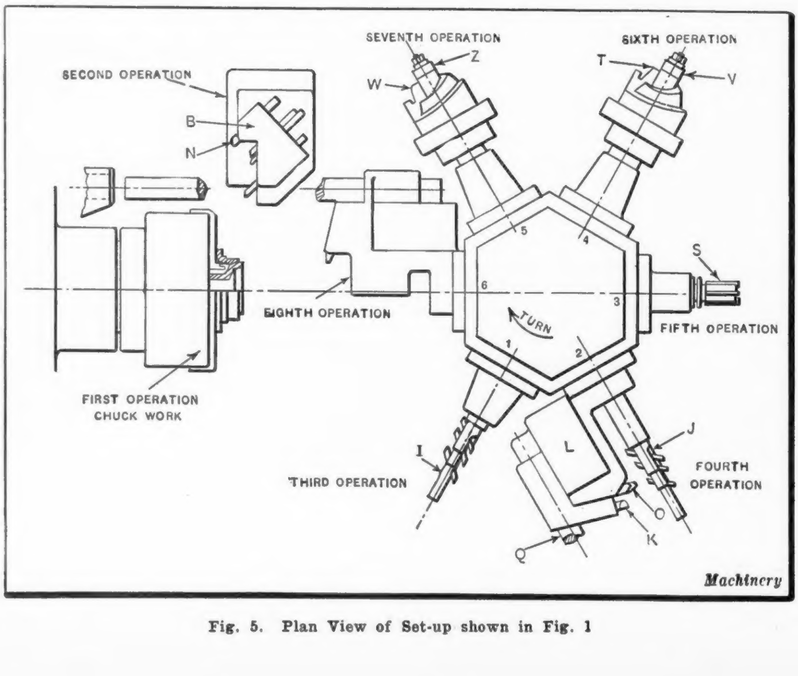


Fig. 5. Plan View of Set-up shown in Fig. 1

the cutter finally adjusted by means of screws *F*. The gage bar *G*, Fig. 7, is mounted in a square turret so that its upper surface is at the height to which the face of the forming cutter is to be set. Thus, the short straightedge *H* can be used in setting the cutter in the manner indicated.

An important feature that tends to increase production and maintain accuracy is the provision of two sets of boring-bars and rear cutter-holders. By the use of set-up gages, the reground tools for the extra set of boring-bars and the rear cutter-holder can be properly adjusted in the tool department while the other set is in use. One of the gages for setting the boring tools is shown in the upper view of Fig. 7. This practice of providing extra boring-bars relieves the machine operator of the trouble of resetting the cutters, as it is only necessary for him to exchange the bar with the dull cutters for one having tools that have been resharpened and reset in the tool department. The gage used in setting the tools of the finish boring-bar is ground to an exact duplicate of the work, so that it is an easy matter to set the tools accurately in place.

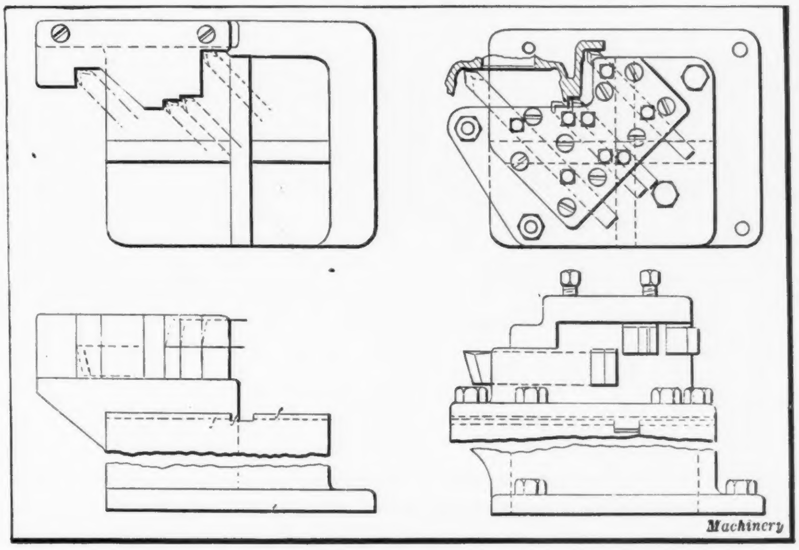


Fig. 6. Set-up Gage used in setting Tools used on Rear Cross-slide

* * *

NEW TURBINE LOCOMOTIVE

Keen interest has been aroused in the railway field by the new turbine locomotive designed by a Swedish inventor, Fredrik Ljungstrom, which is now operating successfully in regular service on the Swedish state railways. Leading British locomotive and traffic experts were sent to Sweden to follow the performances of the turbine locomotive, and in the latter part of 1923 the firm of Beyer, Peacock & Co. obtained a license to manufacture this type of locomotive in England. The new turbine locomotive will also soon be seen in the United States, arrangements now being under way for the construction of both passenger and freight locomotives. An order has been placed by the Argentine Republic for a locomotive of this type, and it is said that the use of the Ljungstrom locomotive on an Argentine railroad would effect a direct saving of $15,000,000.

The first turbine locomotive was placed in regular service in 1922, and the following year was dismantled, the main units being exhibited at the Tercentennial Exposition at Gothenburg. During this time some of the parts of the locomotive were redesigned on the basis of the experience gained in service, the most important change being the replacement of the stationary type air preheater with a new rotating type, which has been used with marked success in power plant service. With these changes incorporated, the locomotive was reassembled during the latter part of 1923 and again placed in service.

Since October, 1923, it has been operated in various classes of service in order to demonstrate its durability and adaptability. It was first employed in switching service, particularly to ascertain the reliability of the reversing mechanism and the ease with which it could be controlled, as well as to demonstrate its high starting power. It was then placed in service on a slow freight run with nine stops in a distance of 25 miles. The performance of the locomotive in starting and accelerating heavy freight trains is said to have been entirely satisfactory. After completion of the local freight trials, the locomotive was taken out of service and carefully inspected. The only defect that was discovered was one leaky boiler tube. With this exception no repairs were found necessary, except the renewal of brake-shoes, etc. The locomotive was next employed in express train service on the main line between Stockholm and Gothenburg, with highly satisfactory results. Among the advantages claimed for this type of locomotive is a 40 to 50 per cent fuel saving.

* * *

CHECKING DRAWINGS

By HERBERT W. CABLE

In checking a working drawing, there is probably no greater aid to the detection of an error than some systematic procedure. Perhaps the most frequent item to escape attention is the missing dimension. The writer has found, however, that the missing dimensions are practically sure to be caught by always checking what he chooses to call the "fourth dimension." Every detail, every machined surface, ribs, holes, etc., should be dimensioned for length, breadth, thickness, and position or location, which we will term the fourth dimension.

Assuming that we are checking the detail drawing of a part, we should ask ourselves the following questions:

1. How wide is the piece?
2. How thick is the piece?
3. How long is the piece?
4. What are the "fourth dimensions" which determine the location of the piece in the general assembly?

If the part is a casting, the cores, bosses, ribs, etc., should next be considered in the same order, asking the same questions in regard to each. The machining operations should then be followed through in the same manner, considering the planing, milling, and shaping operations first; then the bores, tapped holes, and other details.

When this has been completed, it will be evident that the checker has mentally performed the machining operations on the piece and has checked the dimensions as well as the methods of machining. If this procedure is followed, mistakes will be less frequent, and time saved.

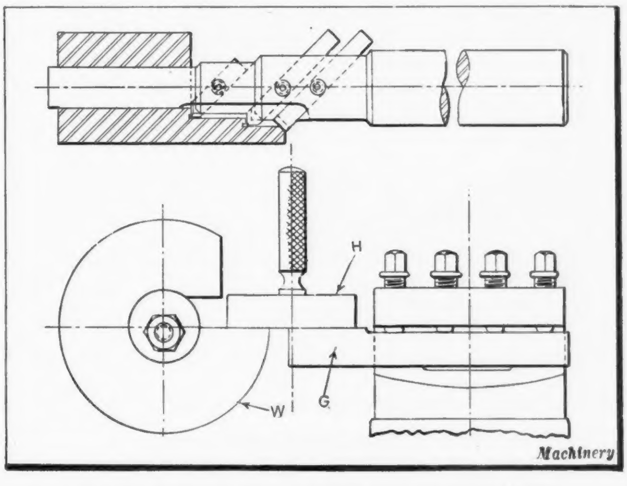


Fig. 7. Gages used in setting Boring and Facing Tools

What Our Readers Think

on Subjects of General Interest in the Mechanical Field

THE SCARCITY OF SKILLED MEN

Although thousands of men who entered the mechanical field during the war became skilled workers, it is said to be difficult now to obtain first-class toolmakers and machinists. Unquestionably, the productive capacity of our machine-building industry at the termination of the war greatly exceeded any peace-time demands that could possibly be made upon it. Then where are the skilled men that at that time were available in the industry?

The law of supply and demand naturally forced the prices of machine tools and machinery in general to a lower level, along with the prices of other products. But in this readjustment has the basic price of machinery been established at its proper level? Has not the level of prices been set so low that the highly skilled man in the machine shop field has found it more profitable to enter other fields?

The law of supply and demand may be expected ultimately to raise the prices of machinery to a more equitable footing with the products of other industries. However, the present disparity is bound to have a detrimental effect, not only on the machinery industry, but on our whole industrial and economic welfare. Obviously, readjustment must be made in order to keep the skilled workers in the machine-building industry, which is one of the most important key industries in peace and prosperity, as well as in war. F. C.

PRESENTATION OF FORMULAS

To be of the greatest practical value, formulas should be made as simple as possible without sacrificing clarity. If a formula is necessarily of a complex nature, a completely worked out example showing its application to a practical problem should be given. There are few faults in technical articles or text-books more inexcusable than the failure to state definitely and clearly what each symbol in a formula represents. This information should be in close proximity to the formula itself and should be so arranged that it stands out from the text.

Writers of technical articles and books should remember that, while there are many readers who make it a point to read carefully every discussion and follow out closely the derivations of every intricate formula that pertains to their work, there are also many men who do not have the time to do this, but who, nevertheless, find practical use for the formulas. For this reason formulas should be presented in such a manner that they can be easily located in the text. They should also be in such form that they can be applied without requiring the user to read all the text matter, or search through it for explanations of symbols that could just as well be given directly before or after the formula.

Recently the writer was confronted with a problem that involved the application of an empirical formula of rather a complex nature. In order to check up the result, the formulas given in various handbooks were compared. In making these comparisons, the writer could not help noting the clear, concise manner in which the formula was given in MACHINERY'S HANDBOOK. Preceding the formula was a short paragraph explaining clearly the conditions under which the formula should be employed, and directly following it were neatly arranged statements which showed at a glance exactly what each symbol in the formula represented. Following this was a carefully stated problem and the complete solution worked out by the use of the given formula.

Writers of technical articles should be encouraged to employ this method of presenting formulas even though it may involve the repetition of some of the statements. Formulas may be termed the "master working tools" of the designer and mechanical engineer, and as such, too much care cannot be taken to make them convenient to use.

D. F.

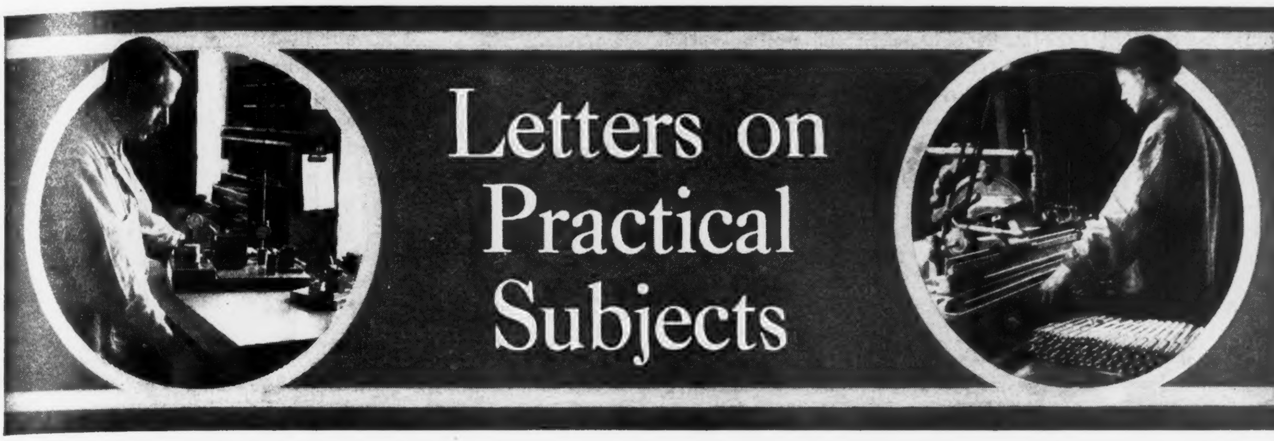
HELPING A BOY TO SELECT HIS LIFE-WORK

It is an almost universal desire on the part of fathers to have their sons attain positions of greater influence in the industrial and social worlds than they, themselves, have occupied. This desire is most noticeable in those men who have had to do hard, manual work and who would like to spare their sons the same experiences. With this end in view, the father will frequently use his savings to send his boys to college. But unfortunately, he often fails to realize that it is far more important to instill in the boy the ambition to succeed than it is to furnish him with the means of an education. If a boy or man is to succeed in any endeavor, he must be vitally interested in that particular endeavor. When he becomes really anxious to better himself, he will succeed, regardless of the handicaps.

Another important point is to select a profession or trade for which the boy shows some aptitude. For instance, it is folly to choose the engineering profession for a boy who dislikes mathematics or lacks the patience necessary to develop projects. When a profession or trade is selected more or less haphazardly for the youth, without first studying his natural abilities, it is probable that the best occupation will not be chosen. The father should be a real chum to the boy, discuss with him the various professions or trades, and if possible have the boy try one or more of them for a short period before actually starting him toward a definite goal. With so close a watch, there will be little danger of selecting an occupation for which the boy is unfitted, unless too much stress is laid on the probable remuneration. However, it must always be remembered that the desire to succeed must be uppermost in the mind of the boy if he is to make any noteworthy advance. K. A. L.

COMMENDATION AND CRITICISM

A word of commendation and appreciation goes a long way toward creating in the worker that spirit of good will and loyalty on which the success of any business enterprise so largely depends. It is probably human nature to speak out when things go wrong and to say nothing when everything proceeds smoothly; and it is, of course, essential to point out errors, for it is through our mistakes that we learn. But if the foreman or superintendent could realize how much encouragement there is in an expression of appreciation, he would make it a point to mention the fact when work is well done. The writer recently heard of an organization in which this policy is followed, with the result that an unusual spirit of harmony prevails. In one case, the manager of this concern was away on his vacation, and he remembered that one of his new men had just completed seven months of highly satisfactory service with the company. He took the trouble to sit down and write that man a letter, telling him how pleased they were with the work he had done and expressing the hope that the association had been as pleasant to the employe as it had been to the employer. The effect was to increase the man's enthusiasm in his work and create a friendly feeling toward the management that will weather many a storm. NEAL BRADLEY

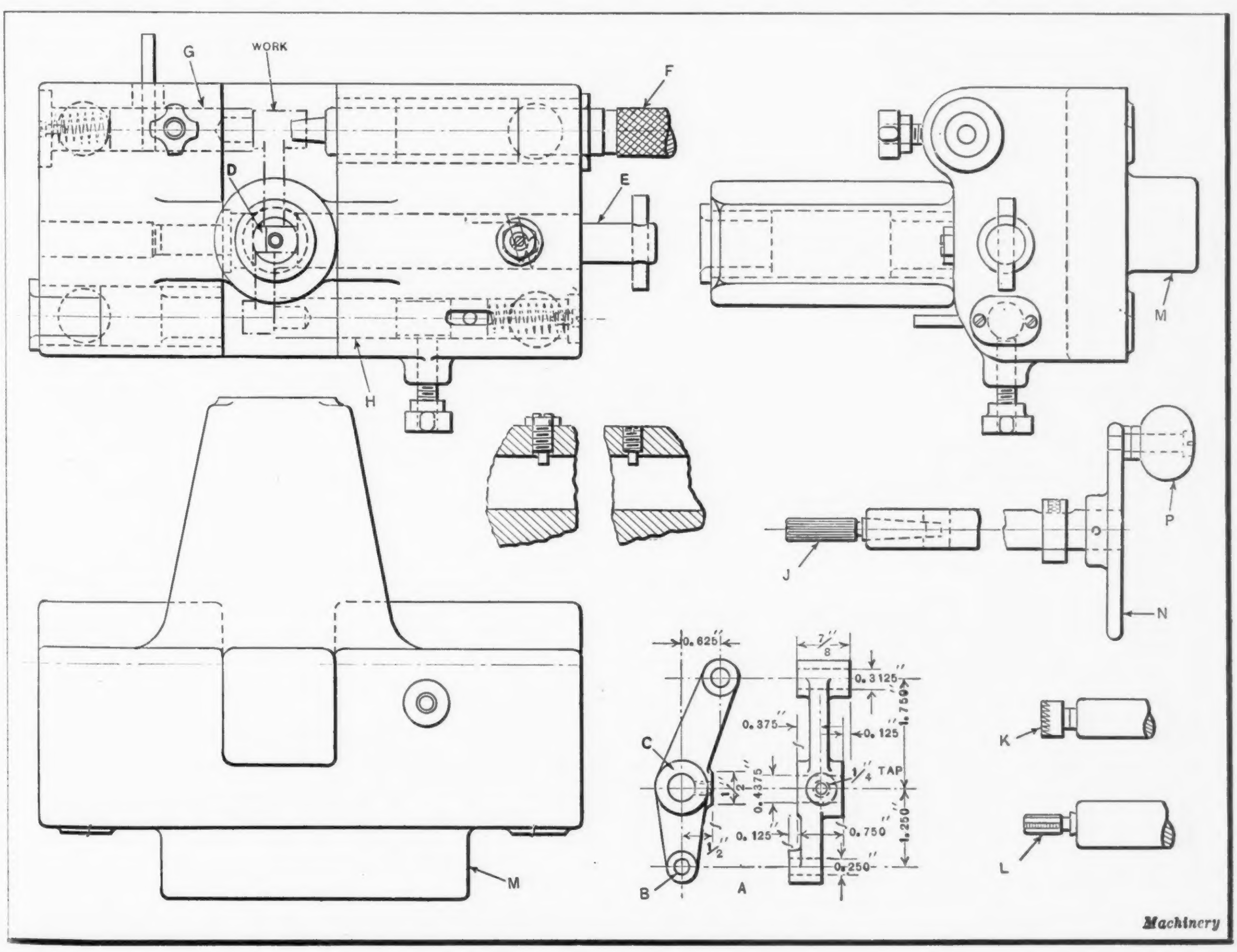


REAMING, FACING AND TAPPING FIXTURE

Fixtures of the type described and illustrated in this article have proved successful in maintaining the high degree of accuracy required in the production of such articles as talking machines, sewing machines, and certain types of automatic manufacturing machines. The particular fixture described was selected as a typical example of the large number of successful hand-operated fixtures used for this class of work. The work shown in the detailed view at *A* is drilled completely, the boss *B* faced, and the 0.4375-inch hole reamed previous to placing the work in the fixture, as shown in the upper left-hand corner of the illustration. The work is located by the plug *D*, and is lightly clamped in place by a plunger-pin *E* of the bayonet type.

Tapered locating plugs like the one shown at *F* are used to locate the two arms of the work in the proper position for the hand-reaming, facing, and tapping operations. The operator must be careful in bringing up the supporting plugs *G* and *H*. These plugs are provided mainly for the purpose of preventing the pressure of the facing tool and the reamers from deflecting the work. It is preferable that the supporting plugs *G* and *H* be of the spring-actuated or fine thread type with suitable locking device. In the case of the spring-actuated type, a means for the positive return or withdrawal of the plunger should be provided, so that it can be moved out of the way to facilitate the insertion and removal of the work. While it is impossible to make a fixture of the kind described that will be sensitive enough to prevent the work from being sprung through the careless manipulation of inexperienced workmen, an effort should be made to so design the locating and clamping members that trouble of this kind will be reduced to a minimum.

After the work is properly located in the fixture, the various reaming, facing, and tapping tools shown at *J*, *K*, and *L*, respectively, are used. The locating plug inserted in the hole selected as the first locating point in the work should be tapered to compensate for variation in the size of the hole. It is possible, however, to plan different operations in which the first locating hole is reamed out in a second



Hand Reaming, Facing, and Tapping Fixture

or finishing fixture; in this case a straight locating plug would be used in the drilled hole when the first-operation fixture was in use. The locating plugs are left in place, and the work-spindles are not removed until it is necessary to do so in order to permit the finishing tools to be used. In this manner, the work is constantly held in position by the plunger in contact with the center hole and by at least one plunger inserted in a hole in one of the arms of the work.

The operations to be performed on various shapes and sizes of work must be considered in designing fixtures of the type described in this article. Also, the conditions encountered when using the fixture, as well as when using fixtures for other operations on the part, must be carefully considered. The fixture shown in the illustration has a cast-iron base provided with bushings for the work-spindles. It also has cast pads for machining purposes, which makes it unnecessary to finish the entire base. The block *M* enables the fixture to be held in a vise which may be provided with means for swiveling, or a swiveling base may be incorporated in the fixture if the nature of the work makes this feature desirable.

The small reamers, taps, etc., used in the work-spindles should have tapered shanks so that they can be removed from the spindles and replaced when necessary. Approximate stops can be used for the tapping spindle, and in the case of the reaming and facing spindles the stops should be ground concentric with the spindle to insure a good contact of the stop-collar on the face of the hub and prevent the tap or reamer from being sprung out of alignment when the spindle is brought up to the stop. In cases where a hole is reamed before tapping, it is desirable that the reamer spindle be an exact duplicate of the spindle that holds the tap. The spindles used for performing operations at different positions of the work may have different diameters so that the possibility of a spindle being used in the wrong position will be eliminated.

It is a good plan to provide racks for holding the various spindles when they are not in use. These racks can be of inexpensive construction, and if conveniently located, will effect considerable saving in time and also protect the tools from being broken or damaged. The handwheels, one of which is shown at *N*, should be designed in accordance with the amount of pressure required to operate the tool; that is, for heavy work the wheel should be of large diameter, and in some cases a handle or knob such as shown at *P* may be used to advantage. For lighter work, however, it is preferable to use a light-weight wheel of small diameter. The spindle wheel should be of such a diameter that a steady motion is obtained, especially when using straight-fluted reamers. The wheel should also be designed so that the operator can easily give the spindle a ringing motion when starting and when finishing the cut. A fast turning motion and a slow feed will give good results in some cases, but it has been the writer's experience that a careful starting movement and a slow ringing finish, with a slow rotary withdrawal of the reamer, gives the best results. Care should be taken not to make the rim of the wheel too heavy, as this might cause the operator's hand to become cramped.

Garwood, N. J. KENNETH M. BOWLBY

BLANKING AND FORMING DIE

The punch and die here illustrated blanks and forms the piece shown in the detail view in Fig. 1. At the first stroke of the press the end of the stock is trimmed to the shape shown at *B*. At the second stroke the piece is cut off along line *I* so that the cut-off piece has the shape indicated at *K*. As the press ram continues downward, the punch *F*, Fig. 2, forces the piece down into the oval pocket at *C*, Fig. 1, so that the end of the piece is turned up and the sides curled in, as shown.

This die wastes very little material as the strip stock used is just wide enough to allow trimming the blank to shape. The stock is fed under the stripper plate of the die, and at each stroke of the press the punch trims the end of the stock to shape and cuts off the end previously trimmed, while the end that is cut off is immediately formed to shape. The heavy dotted lines *D* indicate the position of the stock as it is fed to the left in the direction of the arrow after each stroke of the press.

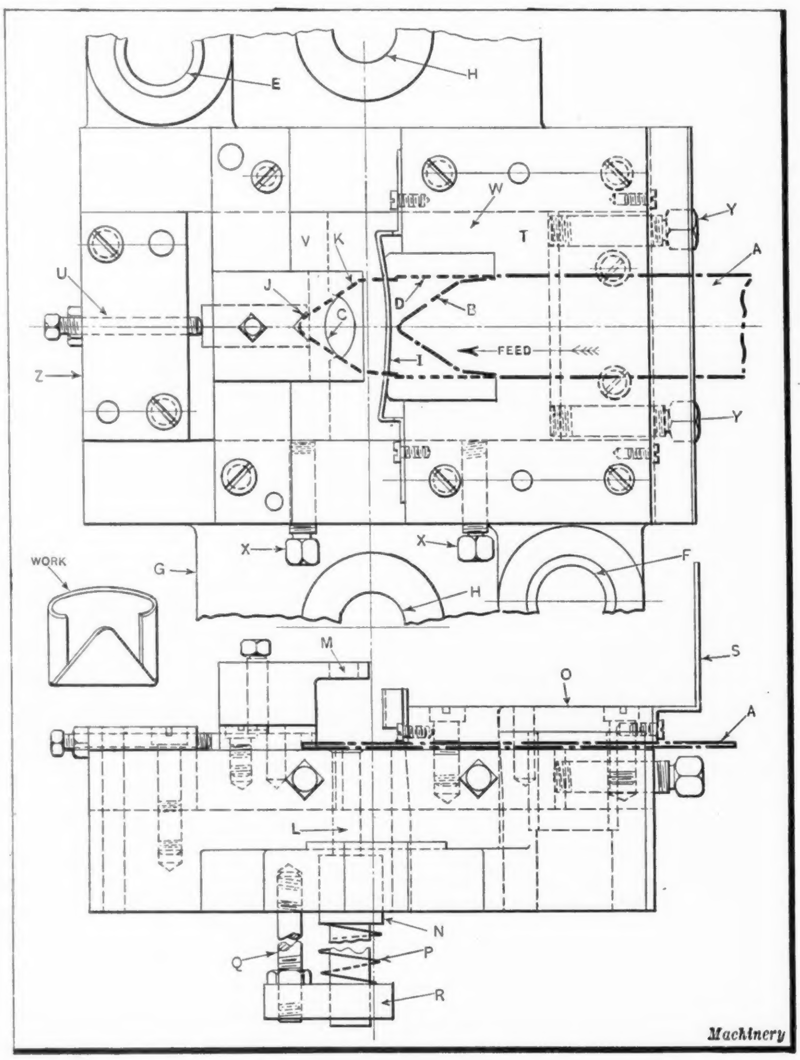


Fig. 1. Blanking and Forming Die

The punch used in conjunction with this die is shown in Fig. 2. The plan view in both Figs. 1 and 2 is taken in the same plane so that the stock is shown in position for feeding from right to left, as indicated. The punch-holder *A*, Fig. 2, is provided with two guide posts *B* and *C* which enter bushings at *E* and *F* in the die, Fig. 1. The bushings, in turn, are held in the die-shoe *G* which is bolted directly to the bolster plate of the punch press by means of bolts in the slots *H*.

The trimming punch *D*, Fig. 2, is securely held to the punch-holder, the inside of this punch being shaped as shown by the outline *E*. In addition, a forming punch *F* is clamped in a block *G* held to the punch-holder by means of a strap *H* and two screws *I* and *J*. Any means could be used to secure these punches in place that would hold the various units rigidly, and permit them to be easily removed

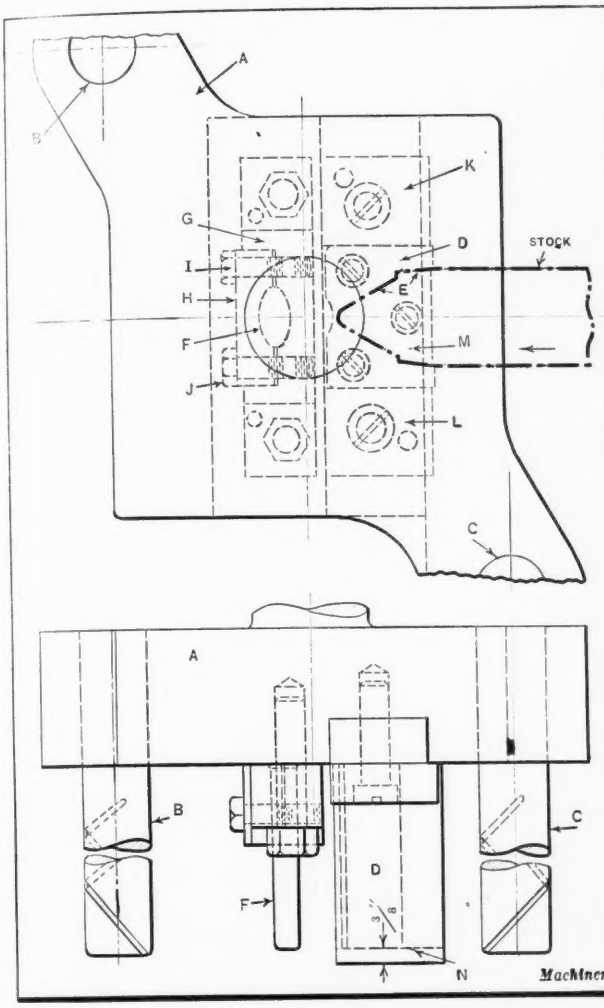


Fig. 2. Punch used with Die shown in Fig. 1

for the replacement of worn parts, but in the present instance the punch *D* is attached by screws and is located by means of blocks *K*, *L* and *M*. It has a step cut in it at *N* which enters the die about 3/8 inch ahead of the cutting surface, backing up the punch before the cutting begins.

Referring particularly to the die construction shown in Fig. 1, the stock *A* is fed through a groove in the stripper plate *O*, which guides the stock sidewise when starting the strip. It is then fed by hand to position, so the outline *B* can be trimmed on the end. The stock is next fed forward under a guide *I* until it comes against a stop *J* made in the form of a vee, which centers it from the end radius. The punch then descends and cuts off the stock on the line *I* and trims the outline *B*, leaving the end *K* (previously trimmed to shape) lying on the top of the die. The stock cut away of course passes through the hole in the die. However, the blank *K* is not left there, as the punch *F*, Fig. 2, strikes it just after it is cut off and forces it into the oval shaped hole *C*, Fig. 1, in the die, drawing it to the shape shown in the detail view.

During this shaping operation, spring plunger *L* (shown in the lower view) is carried down by the punch, and as the punch ascends after forming the work, the spring plunger carries the work up on the punch until its open edge comes in contact with the stripping block *M*. The stripping block forces the work off the punch, the spring plunger being prevented from coming above the working level of the strip stock by the large end *N* of the plunger which comes in contact with the upper side of the counterbored hole in which it operates. A plate *R* held by three screws *Q* forms a buttress against which the spring *P* is held. This spring comes against the shoulder *N* and holds the spring plunger up, so that the forming punch must press the plunger down as it descends.

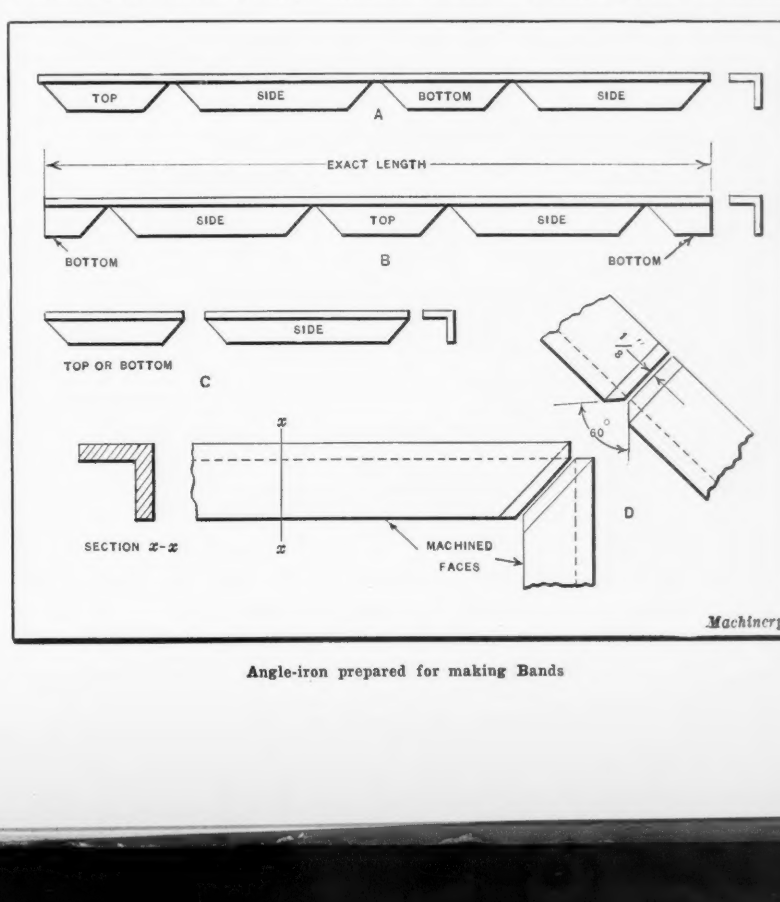
It will be apparent from the foregoing that it is only necessary to feed the stock forward after each stroke of the press, the work being formed and the end of the stock trimmed to shape preparatory to the making of another part which may be cut off and formed when the press again descends. This die is held in a tilting type of punch press, so that as the work is formed and stripped from the punch it will drop out through the back of the press. The strip stock is fed by hand, and a thin plate is provided at *S* through which the stock feeds, and which prevents the operator from getting his hand under the die.

The various sections of the die, of which *T* is one part and *V* another, are held in a groove *W* in the die-shoe by means of screws *X*, while screws *Y* force the various sections of the die to the left against a block *Z*. Screw *U* backs up the feeding stop having the vee slot *J* in it. Dies of this type stand up well in service. F. SERVER

ARC-WELDING ANGLE-IRON HOOPS AND BANDS

The writer has found that angle-iron bands and hoops can be produced at less expense when arc-welded than when welded at the blacksmith's forge. A piece of angle-iron which is to be made into a rectangular band by the blacksmith must be cut to length, straightened, edged, and mitered, as shown at *A* and *B* in the accompanying illustration, the form shown at *A* being the one generally employed. If the band is to be a fairly large one, say 4 by 6 feet, the angle-iron, being in one piece, will be so long that three men will be needed to handle it satisfactorily. It may also be necessary to make two set-ups in order to finish the edge of such a long piece of angle-iron.

In preparing angle-iron for the production of a rectangular band by arc-welding, four pieces would be used, two for the sides, one for the bottom, and one for the top, as indicated by the view at *C*. By using four short pieces instead of one long piece, it is possible for one man to perform the machining and straightening operations. The arc-welding method, besides reducing the labor cost, makes it possible to produce any number of bands of exactly the same size. With this method one man can make any size of band without any help, because he has only short pieces to handle.



Angle-iron prepared for making Bands

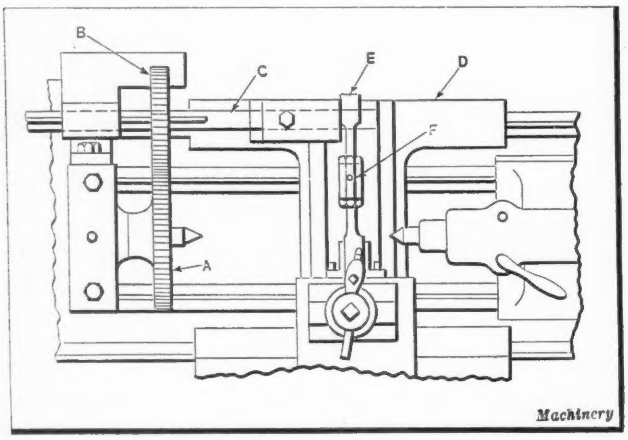
These pieces are set up to stops and clamped to a cast-iron table so that they form a square of the exact size required. After the stops have been correctly set, all the succeeding bands will be of the correct size, or duplicates of the first.

The method of machining the ends that are to be joined by arc-welding is illustrated by the view at *D*. It will be noted that the pieces to be joined are so located that there is a clearance of 1/8 inch between the bevel ends. The mitered ends are beveled, as indicated in the illustration, and the groove formed by the beveled ends is built up or filled in when the pieces are joined by the welding operation. For angle-irons over 1/2 inch thick, it has been found best to bevel both sides of the mitered ends that are to be joined to an angle of 30 degrees, thus forming grooves on each side that have included angles of 60 degrees.

Galt, Ontario, Canada THOMAS C. SMILLIE

TURNING JOGGING CAMS IN AN ENGINE LATHE

The accompanying illustration shows the manner in which an engine lathe was equipped for turning jogging cams for paper mill screens. These cams are 12 inches long and 4 5/8



Lathe equipped for turning Jogging Cams

inches in diameter. The ratio between the gears *A* and *B* determines the number of lobes turned on the cam. When the lathe is in operation, the shaft *C* is driven by the lathe spindle by means of gears *A* and *B*. Shaft *C* is a sliding fit in gear *B*, but is prevented from turning within the gear by a key. This construction permits the lathe carriage *D* to be traversed in the regular way. The eccentric strap *E* at the end of shaft *C* is attached to the cross-slide of the lathe, so that the cross-slide is given the inward and outward movement required to form the lobes on the cam. At *F* is a turnbuckle having right- and left-hand threads, which permits the position of the tool to be readily adjusted.

Pittsfield, Mass. WILLIAM A. LAPONT

SHEARING DEVICE FOR DROP-HAMMERS

It is general practice to cut the last drop-forging of every heat from the bar before the latter is placed in the furnace for reheating. In some cases this means that from 1500 to 2000 pieces must be cut off in a day. The usual equipment for cutting off copper drop-forgings consists of a cutting knife installed on the bed of the press and a second knife on the hammer. It hardly seems good practice, however, to employ a 600- or 800-pound hammer for cutting off copper bars or strips that are only 1/16 inch or less in thickness

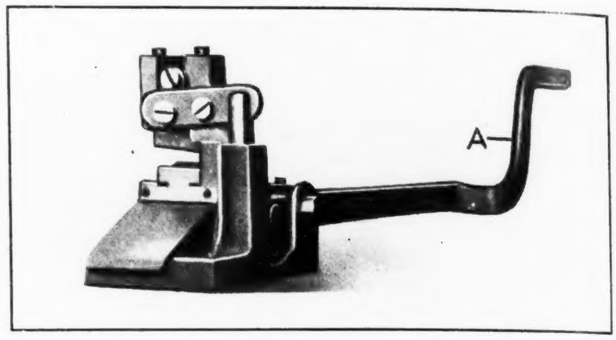


Fig. 1. Shearing Device for Drop-hammers

when the piece can be cut off just as quickly with a small hand- or foot-operated shearing device. It has been found that the blows of the drop-hammer, when shearing off small pieces, are injurious to the dies and have a tendency to crack the hard-wood lifting boards which are more or less expensive and difficult to replace.

The hand-operated shearing device shown in Figs. 1 and 2 was designed to relieve the drop-hammer of this work. The shearing device has proved very satisfactory for cutting off small drop-forgings from the bar stock, as well as for cutting cables and copper wires of various kinds. The shear or cutter is installed between the left-hand upright of the drop-hammer and the die, and is set far enough to the rear to clear the hammer. The long lever *A* is bent upward and to one side, in order to give sufficient clearance for the operator's hand. The important dimensions of the device are given in Fig. 2, and the construction is so clearly shown by the illustrations that no additional explanation should be required.

Bloomfield, N. J. JOHN E. UNGER

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During the ten years beginning January, 1914, it is estimated that the American public spent $17,000,000,000 for automobiles, or an average of $1,700,000,000 a year. During the same period savings bank deposits increased from $5,000,000,000 to nearly $8,000,000,000. The assets of building and loan associations rose from $1,250,000,000 to $3,350,000,000, while life insurance, in force, increased from about $22,000,000,000 to $56,000,000,000. Railroad revenues increased from about $3,000,000,000 to $6,500,000,000.

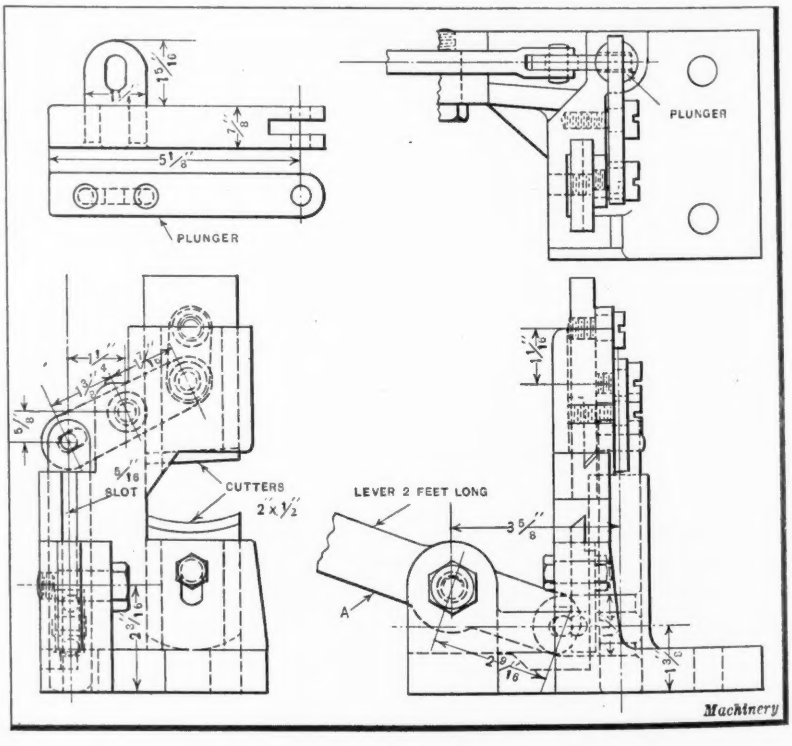
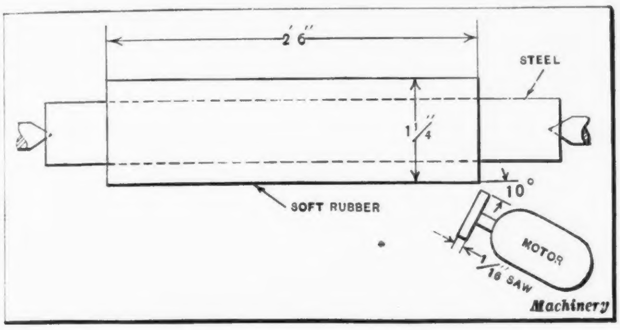


Fig. 2. Details of Device shown in Fig. 1

Shop and Drafting-room Kinks

TURNING A SOFT RUBBER ROLL

The application of a lathe center grinder for turning off 1/8 inch of stock from a soft rubber roll is shown diagrammatically in the accompanying illustration. A saw 1/16 inch thick is mounted on the center grinder spindle in



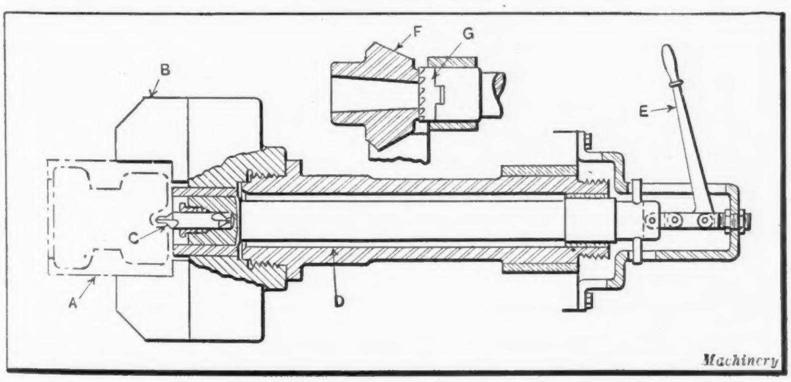
Using a Motor-driven Saw for turning Soft Rubber Roll

place of the grinding wheel. The grinder is set at an angle of 10 degrees with the axis of the roll which is to be turned down, and the saw rotated in the opposite direction from that in which the work is revolved. In this way the stock can be removed quickly, and a smooth surface obtained.

Beverley, Mass. GEORGE WARMINGTON

BACK-CENTERING DEVICE FOR LATHE OR SCREW MACHINE

In the accompanying illustration is shown a piston *A*, which is clamped in a chuck *B*, ready to have the open or skirt end bored, faced, and turned. While these operations are being performed, a center can be drilled in the top of the piston by means of a combination center drill and



Arrangement of Back-centering Device for Use in a Lathe or Screw Machine

reamer *C*, held in a non-revolving bar *D*. As bar *D* has bearings in the spindle of the machine and also in the chuck, a high degree of concentricity is obtained.

The feeding movement is obtained by means of a toggle mechanism operated by a hand-lever *E*. By adjusting the position of the fulcrum of one of the toggle links, the feeding movement can be stopped at any desired point. The same spindle equipment can also be employed for facing a bevel pinion, as shown at *F*, with a spot-facing tool *G*.

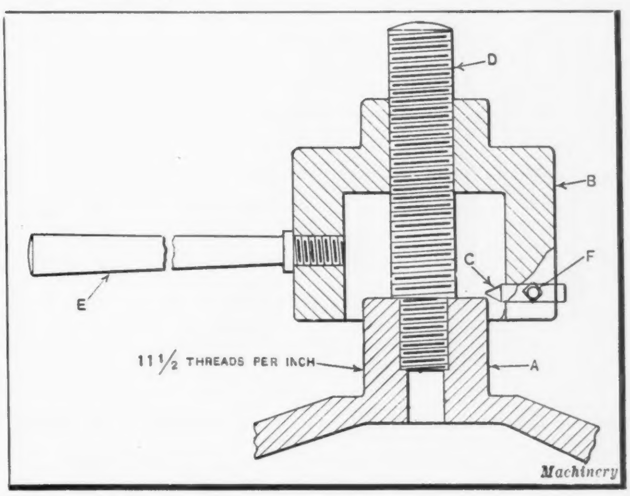
Detroit, Mich. KARL F. MARX

IMPROVISED THREAD-CUTTING TOOL

In the accompanying illustration is shown a thread-cutting tool rigged up by the writer for cutting a thread on the hub *A* of a brass casting that was too large to be threaded on any of the machines available. The threading tool *C* is held in a casting *B* which is threaded to fit the large end of stud *D*. The small end of the stud is threaded to fit the tapped hole in hub *A*. The large end of stud *D* has 11½ threads per inch and serves as a lead-screw when cutting the thread on hub *A*. A handle *E*, about 12 inches long, is screwed into one side of holder *B*.

From the preceding description, it will be evident that when holder *B* is revolved in a clockwise direction, the threading tool *C* will come in contact with the work and cut a thread on hub *A* having the same pitch as the thread on stud *D*. The threading tool *C* is held in place by a set-screw *F* and can be set to take any depth of cut that is practicable.

West Philadelphia, Pa. ROBERT MORRIS

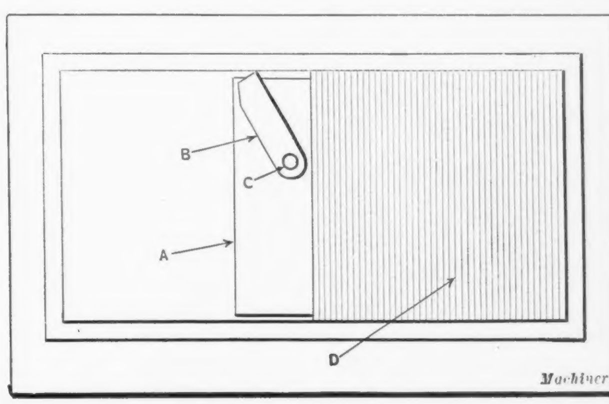


Hand Threading Tool for Special Job

BACK-STOP FOR SMALL CARD FILES

A back-stop for keeping the cards of a small file in a vertical position is shown at *A* in the accompanying illustration. It consists simply of a sliding block of wood with a sheet-metal pawl *B* secured to the top face of the block by a nail *C*. The end of the pawl coming in contact with the side of the file or card container, holds the block in a fixed position against the pressure exerted by the closely packed cards *D*.

Seneca Falls, N. Y. H. E. JEWETT



Card File provided with Simple Back-stop

Questions and Answers

PRESS TOOLS FOR MOUTH-PIECES

C. E. H.—Can anyone suggest a method of making the piece shown in Fig. 1 with dies? We now spin these parts, but, having several thousand to make, think dies would be better. The parts are known as "mouth-pieces," and are used in connection with milking machinery. They are made of 22-gage copper, and are nickel-plated after manufacture.

A.—The pieces shown in Fig. 1 could best be made by a combination of presswork and spinning, but a lay-out is given for making them completely on the press, so that a comparison can be made with the present method of production and, if desired, a combination of the two can be employed. The sequence of operations is shown in Fig. 2 from *A* to *H*, but it may be found necessary to introduce another draw between *A* and *B*, according to the material used. In Fig. 3 is shown the first-operation tool for blanking and drawing in a double-action press, the blank being cut out by the punch *J*, which also acts as a blank-holder while drawing with the punch *K* and die *L*. *M* is the cutting die, and *N* the ejector, which is operated positively on the up stroke of the press.

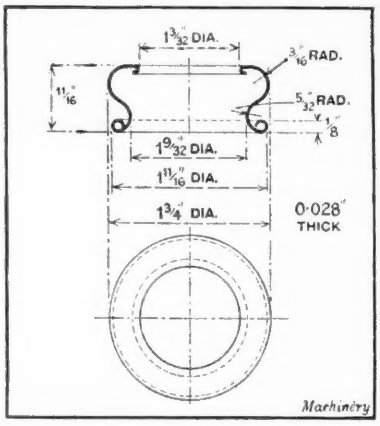


Fig. 1. Mouth-piece for Milking Machine

The tool shown in Fig. 4 is for trimming the flange and turning it up ready for curling. The stripper, cutting die, and punch are lettered the same as in the previous illustration, but the punch *J* also acts as a die for turning up the flange, in conjunction with the punch *R*, while the spring-operated pad *P* ejects the piece from the punch *J*. The curling die is shown in Fig. 5, the piece being located on the bottom die *S*, and ejected from the top tool *U* by the pin *T* on completion of the operation.

The tool for the next operation—bulging—is shown in Fig. 6. When moved to the center by three cams, one of which is seen at *X*, the three slides *V* form a complete circle to embrace the lower part of the work while it is being bulged by the rubber *Z* and the punch *a*. The slides are held down by the plate *W* and are moved outward by the springs *Y*, upon the return of the punch. The rubber *Z* also acts as an ejector for the finished part, as shown at *b*. Fig. 7 shows the piercing tool corresponding to operation *F* in Fig. 2. It will be noticed that a piece of rubber *C* is placed around the punch to act as a stripper, which leaves the die open for feeding and removing the parts. The edge is shown turned in ready for beading in Fig. 8, and the tool used for beading is shown in Fig. 9.

* * *

The machine tool industry in France, according to *Commerce Reports*, has been recovering from the depression of the last five years. The large stocks of American machine tools on hand at the end of the war have been gradually disposed of, and on account of the exchange rate, the local demand for machine tools is turning to French manufacturers.

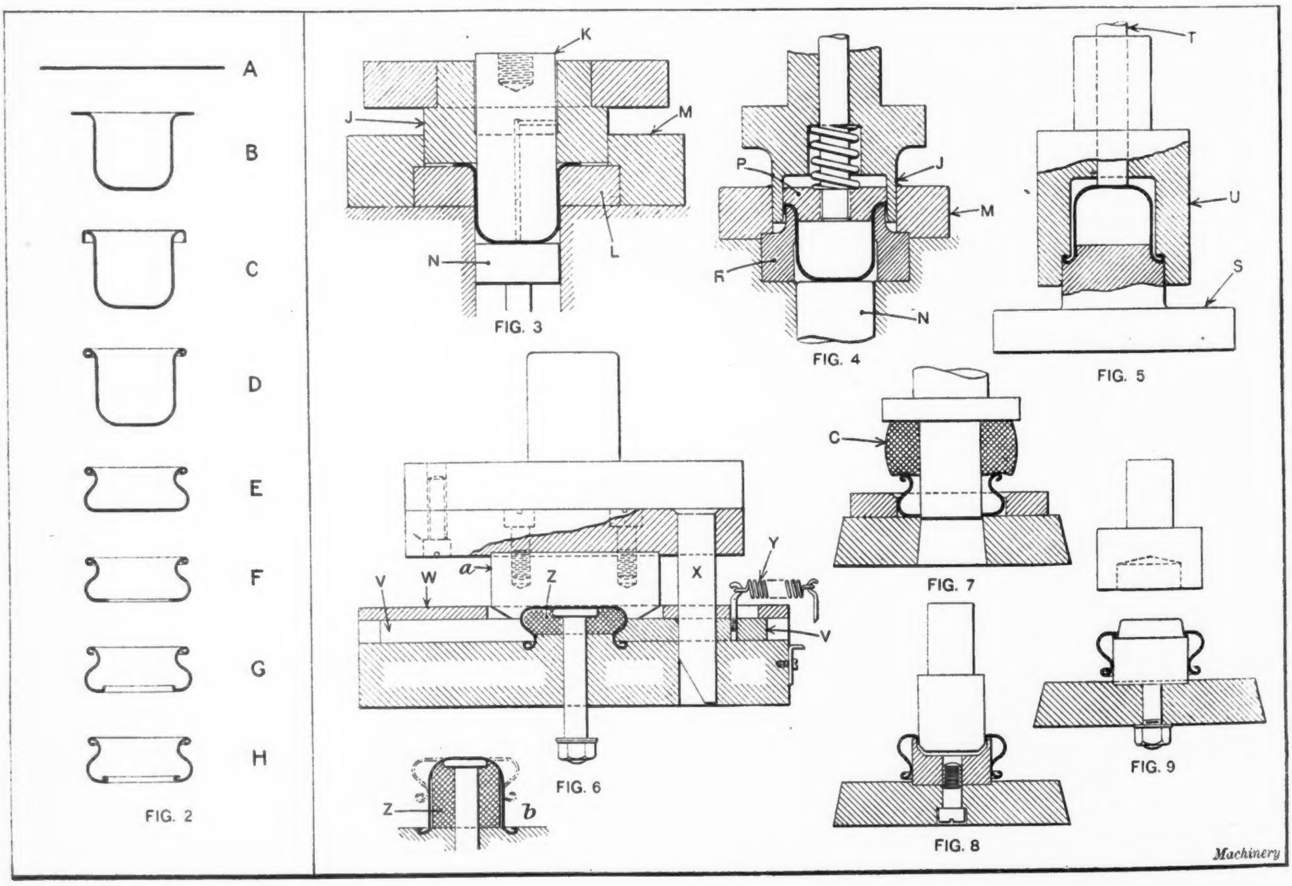


Fig. 2. Sequence of Operations. Fig. 3. Blanking and Drawing Die. Fig. 4. Tool for trimming Flange and preparing it for the Curling Operation. Fig. 5. Curling Die. Fig. 6. Bulging Tool using Rubber Pad. Fig. 7. Die for piercing the End of the Mouth-piece. Fig. 8. Operation preparatory to Beading. Fig. 9. Final Beading Operation

MACHINE TOOL STATISTICS FOR 1923

The Department of Commerce announces that according to data collected in the census of manufactures for 1923, the establishments engaged primarily in the manufacture of machine tools report products valued at $136,871,096, an increase of 102 per cent as compared with 1921, the last preceding census year.

In 1923, according to the census, machine tools were built in 350 shops in twenty states. The leading states and their productions were as follows:

State	Value
Ohio	$36,423,371
Pennsylvania	12,713,907
Massachusetts	12,361,593
Connecticut	11,477,374
Illinois	11,307,749
Rhode Island	10,393,185
New York	10,195,887
Other states	31,998,030

The number of shops, as distributed between the various states, were as follows: Ohio, 95; Pennsylvania, 26; Massachusetts, 38; Connecticut, 27; Illinois, 30; Rhode Island, 10; New York, 23; Michigan, 29; Indiana, 13; New Jersey, 13; and Wisconsin, 13. The other 33 shops, not accounted for by the states mentioned, were distributed in the remaining nine machine tool building states.

Ohio produced 26.6 per cent of the machine tools built, by value; Pennsylvania, 9.3 per cent; Massachusetts, 9 per cent; Connecticut, 8.4 per cent; Illinois, 8.3 per cent; Rhode Island, 7.6 per cent; and New York, 7.4 per cent. The remaining 23.4 per cent was produced in the other thirteen machine tool building states.

The average number of wage earners, not including salaried officers and employes, nor proprietors and firm members, averaged 33,277 in 1923. The largest number employed was in June, when a maximum of 34,849 was reached. The minimum employment was in January, with 30,061 employes. The wages paid during 1923 in this industry amounted to $47,237,658. The cost of the material, including the cost of fuel and packing and boxing materials, was $40,838,200, and the value added in the industry to the raw materials to produce the final product was approximately $96,000,000. The machine tool industry used about 110,000 horsepower in furnishing its plants with power, and consumed nearly 174,000 tons of coal.

* * *

An Employe Representation Conference will be held by the American Management Association at the Hotel Winton, Cleveland, Ohio, November 13 and 14.

COMPARATIVE STATISTICS OF MACHINE TOOLS IN 1921 AND 1923

Kind of Machine	1923		1921	
	Number	Value	Number	Value
Bending machines	616	$616,443	54	$164,315
Boring machines:				
Horizontal	475	1,209,867	632	1,340,106
Vertical	323	2,345,772	266	1,840,792
Broaching machines	235	347,317	530	616,933
Cutting-off machines:				
Rotary cutter type	299	404,467	*	*
Hacksaw type	652	207,873	*	*
Drilling machines (except portable):				
Multiple-spindle	2,081	3,431,563	676	1,106,097
Radial	922	2,431,268	722	1,360,233
Sensitive	2,612	1,228,455	1,428	227,601
Upright	2,506	1,048,781	1,677	603,156
Forging machines:				
Bulldozers	96	711,992	*	*
Bolt, nut, and rivet	24	100,885	*	*
Other	.....	....	*	*
Gear-cutting machines:				
Automatic, formed cutter, templet generator hobbing, and generator planing or shaping types	837	2,581,806	834	1,698,243
Other	270	924,400	10	38,424
Grinding machines:				
Cylindrical				
Plain	1,919	1,715,736	1,789	1,666,101
Universal	1,672	1,513,325	692	656,184
Surface	3,789	2,122,134	271	337,620
Cutter, tool and knife	571	404,549	435	319,396
Internal	515	888,620	276	345,029
Other	11,069	1,137,318	208	69,136
Hammers (not portable):				
Steam or pneumatic	1,435	585,042	2,607	814,394
Drop	122	164,220	502	120,139
Power (belt- or motor-driven)	420	126,466	*	*
Other	.....	....	541	179,171
Lathes:				
Engine	7,295	8,884,904	5,117	5,229,884
Bench	950	462,123	1,095	393,112
Turret (including hand screw machines)	2,544	5,320,087	1,077	1,580,842
Other	1,197	4,323,371	333	1,440,017
Planers	293	2,032,945	194	1,271,824
Milling machines:				
Hand feed	274	93,794	468	233,945
Power feed				
Plain	1,063	1,881,709	536	812,346
Universal	453	959,967	594	1,092,234
Vertical	328	770,541	212	415,275
Lincoln type	194	438,950	32	32,997
Planer type	56	672,969	173	696,685
Other	538	1,229,295	258	539,776
Pipe cutting and threading machines	1,952	992,397	1,192	570,509
Portable tools:				
Drilling, electric, and pneumatic	96,729	5,392,626	20,809	1,886,978
Hammers, pneumatic (chipping, riveting, calking, etc.)	.....	2,842,611	.....	564,052
Screwing	†	†	67,321	541,232
Grinders, electric	10,894	812,553	*	*
Other	794	265,024	2,127	1,488,349
Presses:				
Hydraulic				
Bending and forming	8,359	3,697,092	885	444,894
Forging	274	124,355	*	*
Power, for sheet-metal work	4,112	2,322,373	*	*
Other	.....	....	2,898	1,198,350
Punching machines (not portable)	1,390	1,119,302	20,045	7,284,166
Riveting machines (not portable)	1,947	658,218	*	*
Screw machines (automatic):	.....	....	2,661*	2,839,667*
Multiple-spindle	954	2,833,781	.....	....
Single-spindle	1,159	2,006,958	.....	....
Shapers	1,569	2,052,805	1,418	1,020,342
Slotters	81	446,363	*	*
Shears (power)	1,763	980,689	3,347	906,722
Threading machines (except for pipe):	.....	....	*	*
Die type	162	277,515	.....	....
Milling type	115	371,968	.....	....
Rolling type	26	15,374	.....	....
Tapping machines	554	424,053	.....	....
All other machine tools	.....	21,947,776	.....	5,486,336
Parts and attachments	.....	25,397,185	.....	8,936,547
All other products	.....	8,571,124	.....	7,319,211
Total value	.....	$136,871,096	.....	$67,729,362

*Not reported separately. †Not reported separately; included in "all other machine tools."

The Machine-building Industries

THE business conditions of the United States taken as a whole have continued to show a moderate improvement during the last two months, although the upward trend has not been as rapid as was expected by some of the business leaders two or three months ago. These improvements in the industrial conditions are evidenced by a marked increase in the output of steel ingots and a fair increase in pig iron production; by an increase in the output of automobiles and increased demand for coal and rubber; by an increase in building permits at a time of the year when there is normally a seasonal decline; by better employment conditions; and by a marked increase in freight movements, establishing new high records for the year that are within less than 2 per cent of the highest freight movement records in the history of the American railroads. In fact, industrial products are being moved at a higher rate than ever before, the week ending September 20 marking the highest volume of merchandise and less-than-carload-lot freight in railroad history.

All of this indicates general industrial activity throughout the United States, the only exceptions in the big basic industries outside of the machine-building field being in the oil and textile industries. In addition, there are two factors that will aid in improving industrial conditions materially—the likelihood of greater stabilization in Europe, and improved conditions in the agricultural regions of this country.

The Machine Tool Industry

The observations of Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, are to the effect that machine tool demand is improving; there are a large number of indications, from statistical facts, that there will be a rise in machine tool sales activity. There has been a steady, although slight, improvement in the machine tool field since June, and it is confidently expected that after election there will be a more decided demand. Inquiries are increasing in number, and while many of these may not materialize into orders until after the first of next year, the outlook is considered decidedly hopeful. It is also to be noted that the second-hand market is not so plentifully supplied with machine tools at present as it has generally been ever since the war. From these indications the conclusion is drawn that 1925 will be at least as good a year in the machine tool industry as 1923 was, particularly for those who have brought out advanced designs in machine tools.

The Iron and Steel Industry

The iron and steel industry is now operating on an average of about 60 per cent of capacity, compared with 45 per cent three months ago, and a general average of 66 per cent since the armistice. The mills of the United States Steel Corporation are averaging from 63 to 65 per cent, while some of the independents have not yet reached 60 per cent capacity. Blast furnaces are being blown in, and the outlook in the iron and steel industry is more hopeful than it has been for months.

Manufacturers and jobbers all over the country have been in the market for steel during recent weeks, and considerable buying of rails has also taken place, although the railway buying has fallen short of the promises of a month ago. Nevertheless, the large orders for freight cars that have been placed by several railroads have added to the demand for steel. The present activity in the iron and steel industry indicates that the curtailment in production in the middle of the summer was probably overdone and that it would have been possible to maintain production at a more even level. The improvement from now on, while gradual, is not expected to be spectacular.

There is no great activity in the pig iron market, and it appears that many buyers are waiting for an assurance of stability in prices before placing orders. The producers appear to be confident that there will be higher price levels about January 1.

The Automobile Industry

The production of automobiles during August, with all producers reported, reached nearly 280,000 cars and trucks. The National Automobile Chamber of Commerce estimates the September output to be about 274,300 cars and trucks. Some automobile dealers confess some disappointment in autumn sales, while others claim that the buying has been good for this season of the year, although not exceptional. Manufacturers are maintaining production in close accord with sales, and there will be no accumulation of stocks until they are making ready for the spring demand. A good feature in the situation is that the dealers' stocks are small and are being continuously reduced. The General Motors Corporation states that its total sales to ultimate consumers up to the end of August were 494,014 this year, as compared with 528,026 last year.

On July 1, 1924, there were 15,552,077 motor vehicles registered in the United States, an increase of 2,549,650 over July 1, 1923. There is now one motor vehicle for each 6.6 persons. The greatest number in proportion to population is found in California—one to each 3.4 persons.

Improvement in the Railroad Situation

The improvement in the general business situation is clearly indicated by the fact that car loadings are steadily increasing, and for some weeks they have even exceeded the figures for the corresponding week last year. The railroads still have a large number of surplus freight cars on hand and are amply able to handle any freight offered them without delay. The increased operating efficiency of the roads is beyond question, both freight and passenger service being better than it has been for many years. The increased efficiency is also evident in the reports of earnings of the railroads, the net earnings being much larger at present than for corresponding periods last year. The railroads are looking forward to a satisfactory traffic and earnings for the remainder of the year.

The National Industrial Conference Board has issued a report on the efficiency of the railroads, in which are taken into account the various directions in which the railroads have endeavored to improve their service to the public. In the six and one-half years preceding December 31, 1922, the number of freight cars in use on the railroads of the United States increased only 3 per cent, but owing to the size of the cars, the freight handling capacity was increased 9 per cent. The total capacity of the steam locomotives increased 21 per cent in the same period. Additional trackage facilities aided in making the operation of longer freight trains possible through the provision of yard tracks and sidings of adequate length. The average number of tons of freight per loaded car increased 13 per cent, and the average number of tons per train, 18 per cent. The railroads handled in 1923 a freight traffic, as represented by the number of ton miles, that was 23 per cent greater than in 1915. The number of ton miles of freight moved by the railroads per man-hour worked by the train and engine crews in the road freight service in 1923 was 14 per cent greater than in 1915, and marks the greatest efficiency in this respect ever attained.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Cincinnati Plunge-cut Grinding Machine

A GRINDING machine equipped with a wheel of a width approximately the same as the surface to be ground, which is fed directly into the work, has recently been developed by the Cincinnati Grinder Co., Cincinnati, Ohio. This machine is particularly adapted for the simultaneous grinding of duplicate parts that can be held in a gang on a mandrel or other convenient chucking device, such as piston-rings, ball-bearing cups, collars, and bushings. It can also be employed for grinding single pieces, in quantity, of such form and dimensions as to lend themselves to the application of a wide wheel, as, for example, transmission shafts, axle shafts, propeller shafts, spindles, pistons, and similar work.

Principles of Design

The construction of the machine embodies a fixed wheel-base, a movable work-table, and a cross-feed mechanism which provides transverse motion to the slide on which the grinding wheel is mounted. The base, wheel-slide pedestal, and water tank are cast in one integral unit. The base rests on three feet, thus giving a three-point support which compensates for any unevenness in the flooring or foundation. The unit system of construction is followed throughout in building the machine and any unit can be readily removed and replaced without disturbing the alignment of other parts. The entire machine is liberally proportioned with the view of insuring permanent alignment.

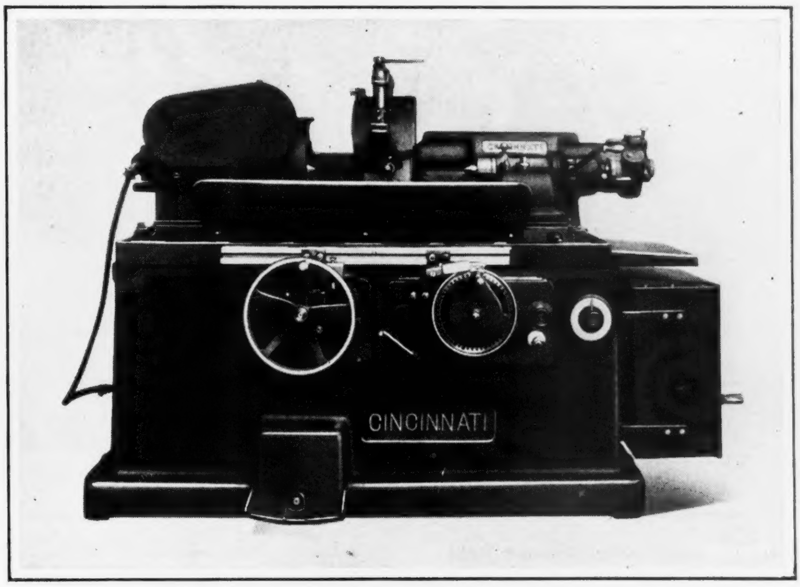


Fig. 1. Cincinnati Wide-wheel Plunge-cut Grinding Machine

The base is provided with one flat and one vee way, the latter serving as a guide for the sliding table which carries a headstock and a footstock for holding the work, and back-rests. At each traverse, the table over-runs the end of the base ways, so that wear is evenly distributed over the entire length of the base and table ways.

The sliding table is controlled by a hand-operated traversing mechanism which is carried by a plate mounted on the front of the bed. This mechanism is used for bringing the work in front of the wheel and in truing the latter. Movement of the table is accomplished by means of a large handwheel, through gearing and a shaft carrying an integral pinion which meshes with the table rack. One revolution of the handwheel advances the table ½ inch. A hinged bracket which can be swung into or out of place, and against which the table dogs operate, forms a positive stop for duplicate setting of multiple work and for returning the table to its original position after truing the wheel. The dogs provide a fine adjustment for grinding to shoulders.

The machine is also provided with a swivel table which is mounted on the sliding table and pivots on a hardened and ground stud. This swivel table can be set at an angle to the ways to permit the grinding of tapers without throwing the headstock and footstock centers out of alignment. It is graduated to read in degrees and taper in inches per foot; adjustment is made through a worm and worm-wheel segment at the end of the table, direct-reading scales indicating the position.

The Drive

Two motors are provided, one being mounted in the headstock housing as shown in Fig. 2, for revolving the work, and the other, or main drive motor, being placed partially in the machine base, as illustrated in Fig. 3. Both motors are dynamically balanced, and can be readily removed and replaced. The main motor and the wheel-spindle driving pulley are connected by means of an endless belt that is held in tension by idler pulleys to insure maximum power input at all times. The machine is rated at 20 horsepower. The machine can also be equipped for a belt drive, in which case a frame carrying a tight and loose pulley is substituted for the main drive motor.

The control is centralized at the front of the machine, the controlling levers being within convenient reach of the operator from his normal position. A foot-treadle on the base is used for starting and stopping the rotation of the work, so that both hands of the operator are left free for loading and unloading the machine.

The Headstock and Footstock Units

The headstock is adjustable on the swivel table, and is locked to it by two stud bolts sliding in a T-slot. The spindle is hardened and ground, and the hole in the front end is tapered to receive the work-carrying center. The drive from the motor to the driving plate is by means of a silent chain and worm. The worm is of steel, hardened and ground, and the worm-wheel is of hard bronze and is partially submerged in oil so that as it revolves it conveys the lubricant to the worm. As the work-center is directly over the center line of the base guideway that is closest to the grinding wheel, there is a support immediately under the work at all times. A V-shaped key on the swivel table engages a corresponding keyway cut into the bottom of the headstock and running its entire length, to preserve alignment between the headstock and swivel table.

The footstock is secured to and preserves its alignment on the swivel table in the same manner as the headstock. It provides a convenient device for receiving the diamond tool-holder and truing the wheel without removing the work. The spindle is actuated either by a screw and hand-wheel or a quick-acting lever. It has a full-length bearing in the barrel, which is split and adjustable to compensate for wear and for controlling the closeness of the sliding fit.

The Wheel-Slide

The wheel-slide is held in place on the long wide ways of the wheel-slide platen by its own weight, supplemented by the downward pressure of the spindle belt, and is counter-weighted to compensate for backlash. Motion is transmitted to the wheel-slide from the cross-feed, which is operated either by hand or automatically, and is provided with a positive stop for duplicate-diameter work when feeding by hand.

One of the principal features of the machine is the continuous power in-feed embodied in the cross-feed which gives twelve rates of speed to the wheel-slide, affording a feed range of from 0.054 to 0.162 inch per minute, any feed being instantly obtainable through an adjustable-speed fractional-horsepower motor. The arrangement provides a uniform or non-intermittent feed during the grinding operation, as the wheel-slide is moved continuously at any predetermined rate within the speed range. Thus, it is said, the wheel is not subject to periodic strains, and requires less frequent truing. The V-way which serves as a guide to the in-and-out movement of the wheel-slide is located approximately centrally between the spindle pulley and the grinding wheel. This arrangement establishes an equilibrium of forces between the pressure of the wheel against the work and the pull of the belt on the spindle pulley, thus neutralizing any tendency for the wheel-slide to skew on its ways. The wheel is adequately guarded.

The wheel-spindle runs in bearings of the half-box type, the body of which is cast iron, lined with a special white metal. The spindle is held in the bearings by the downward pull of the belt, as the drive is direct from a constant-speed shaft immediately under the spindle. Lubrication is accomplished by the use of large-diameter disk-type splashers, mounted on and revolving with the spindle. The splashers are partially submerged in oil reservoirs and convey the lubricant to a collector in each bearing cap, whence it is distributed over the entire spindle journal. A shoe in the bearing cap, which is adjustable downward against the spindle, provides a safeguard in case the spindle belt should break. End thrust is taken by a double-ball bearing which is adjusted by a knurled hand-nut working in the spindle-housing end cap and locked in position by a set-screw. The various adjustments can be effected while the spindle is rotating.

The Reciprocating Wheel-Spindle

Another of the special features of the machine is a reciprocating device, which moves the wheel-spindle back and forth in its bearings in the direction of its axis with a uniform motion, a distance of 3/16 inch fifty times a minute. This reciprocating device can be made operative or inoperative at will. It is claimed that the device maintains an even cutting face on the grinding wheel for a longer period than if the wheel were stationary longitudinally, thus reducing the frequency of dressing and producing a better finish by breaking up the grain lines of the wheel on the work.

Careful provision has been made for lubrication. The ways of the base are lubricated from oil reservoirs fitted with spring rollers. The table traverse apron and the cross-feed plate have localized oiling, the oil being poured through large self-closing cups into a pocket and distributed by tubing to the various bearings. The wheel-spindle has automatic lubrication, as previously referred to.

The machine is built in four sizes, namely, 12 by 18 inches, 12 by 36 inches, 12 by 48 inches, and 12 by 72 inches, the distance between centers for the four machines being 19. 37, 49, and 73 inches, respectively. The size of the grinding wheel is 20 by 2 to 7 inches, on all four machines.

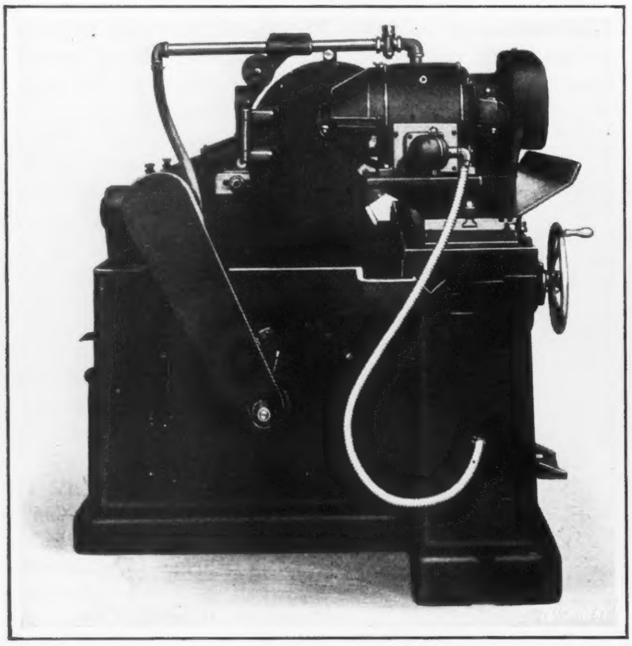


Fig. 2. Left-hand End of the Machine, showing Headstock Motor which revolves the Work

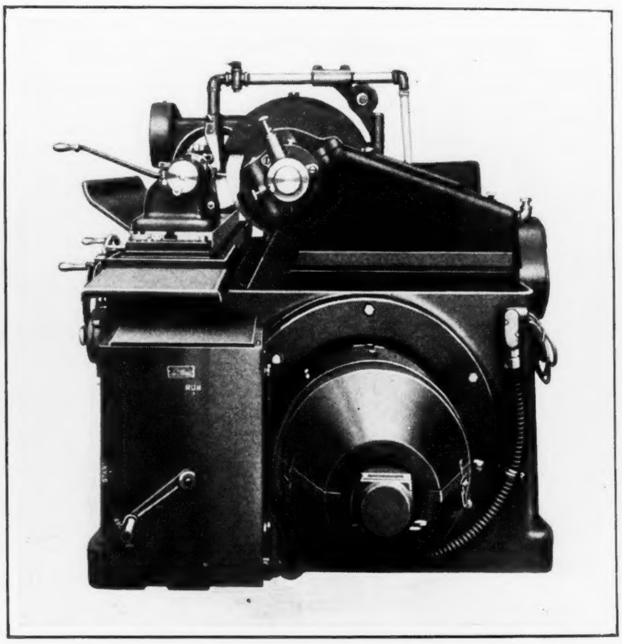


Fig. 3. Right-hand End of Machine, showing Main Drive Motor mounted in Base

WATERBURY FARREL BOLT-TRIMMING AND THREAD-ROLLING MACHINES

New lines of automatic bolt-head trimming machines and reciprocating screw-thread rolling machines have been placed on the market recently by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn. The former are used for trimming the heads of cold-headed bolts and screws into square, hexagonal, or other shapes. There are three standard sizes, having capacities for trimming blanks up to 5/8 inch diameter and ranging in length under the head from 3/8 to 8 inches.

Blanks up to 4 inches in length are fed automatically from a hopper into a chute, and thence to a device which

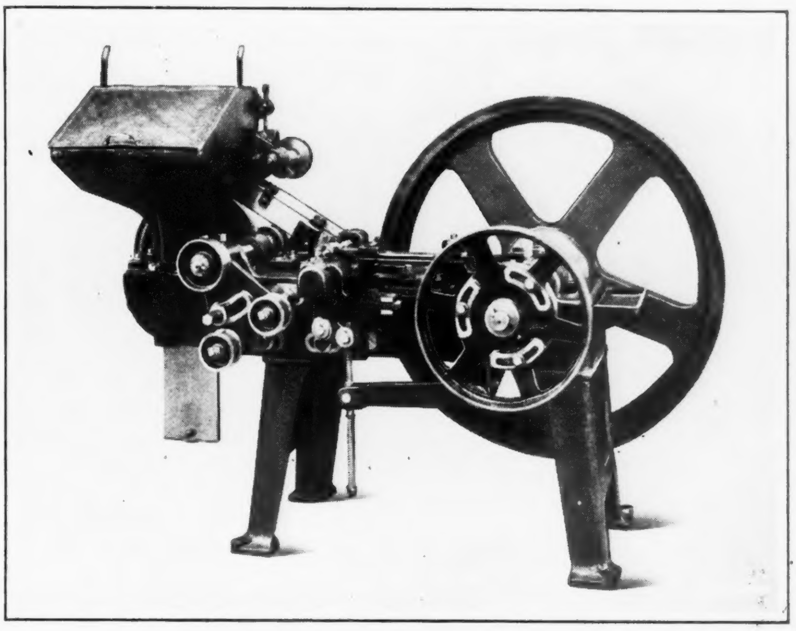


Fig. 1. Waterbury Farrel Automatic Bolt-head Trimming Machine

transfers them to the trimming tools. Longer blanks are usually placed into the chute by hand. The blanks are picked out of the chute from one side by a pair of spring carrier fingers fixed to an oscillating shaft which has bearings in a cross-slide. As the slide advances toward the chute from its backward position and with the fingers swung up to the chute angle, the spring fingers snap over a blank, draw it out, swing it down to the position shown in Fig. 2, carry it to the center line of the tools, and hold it there until after the hollow trimming punch has advanced to encompass the shank. The slide then recedes and the fingers snap off the blank. When the slide is again in its rear position, the fingers swing up to the chute angle preparatory to the next cycle of operations. The hollow punch telescopes over the shank until it comes up against the under side of the head and forces the head of the blank into the trimming die.

The construction of the cross-slide operating mechanism is a feature which the manufacturer emphasizes as especially valuable. This slide is cam-actuated, a safety device being incorporated in the cam-lever which prevents breakage in case an obstruction should prevent the full traverse of the slide. The cam-lever is in reality two levers which act as one so long as there is no obstruction to the free movement of the slide. When there is an obstruction, the joint that ties the two levers together, becomes disengaged and the slide is inoperative. If the obstruction is removed, the joint becomes automatically connected on the next stroke of the machine.

The cam which actuates the slide has a slight over-travel, and the innermost position of the slide is determined by an adjustable stop. When the slide reaches this stop, the over-travel on the cam is taken up by the compression of a spring on the connection between the cam-lever and the slide. The oscillatory motion of the spring-finger shaft is also positively stopped at both extremities of its arc. In case of obstructions to the full angular movements of the fingers in either direction, the incompleted cam movement is taken up by one of two springs in the connection between the cam-lever and the finger shaft. This compensator is shown at the front of the machine in Fig. 1. In the normal operation of the device, a slight over-travel on the cam is taken up alternately by the springs, assuring that the fingers will be held firmly against their stops which are adjustable.

If the space between the punch and the die will not permit two blanks to be held in line, it is necessary to use a knock-out to eject the work from the die, but when medium and short work is being handled, the blanks are trimmed by pushing them successively through the die. To adapt the machine for either method of trimming and for different lengths of work, the transfer slide must be located accordingly along the bed, either toward or away from the die. To simplify this adjustment, the hopper feed and the cross-slide are mounted on an apron so that the two can be moved as a unit without disturbing their relationship.

When a die knock-out is used, the nose of the punch is slightly smaller than the die opening so that it will enter the die far enough to complete the shear in one stroke. Usually, however, when the more common method of pushing the blanks through the die successively is employed, the nose of the punch does not enter the die but simply backs up the head during the trimming operation which is not entirely completed until the next blank is abutted against it. In all cases the punch is provided with a knock-

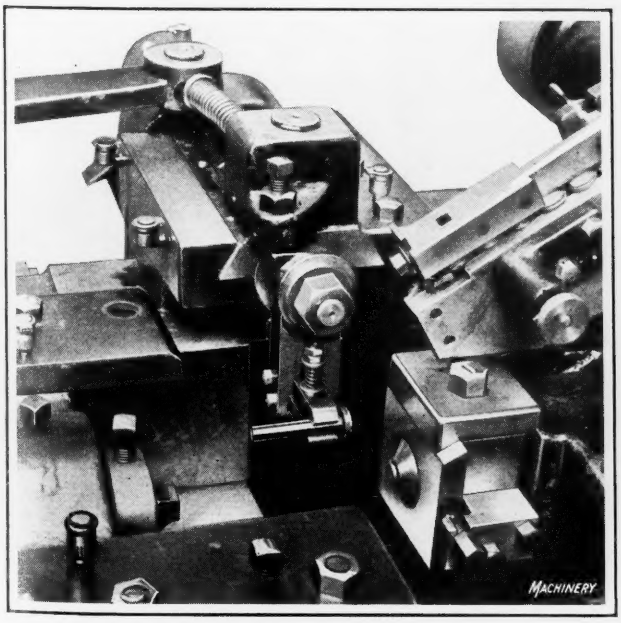


Fig. 2. Mechanism which transfers the Blanks from the Chute to the Trimming Tools

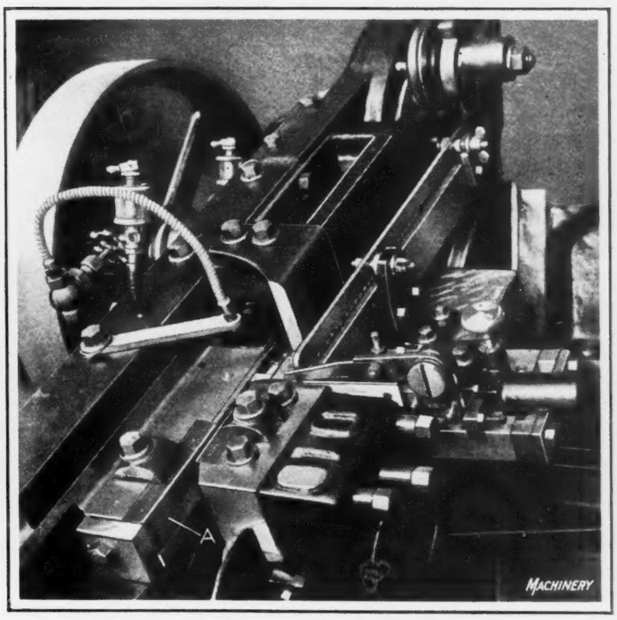


Fig. 3. View of the Dies, Chute, Transfer Slide, etc., with which the Thread Rolling Machines are equipped

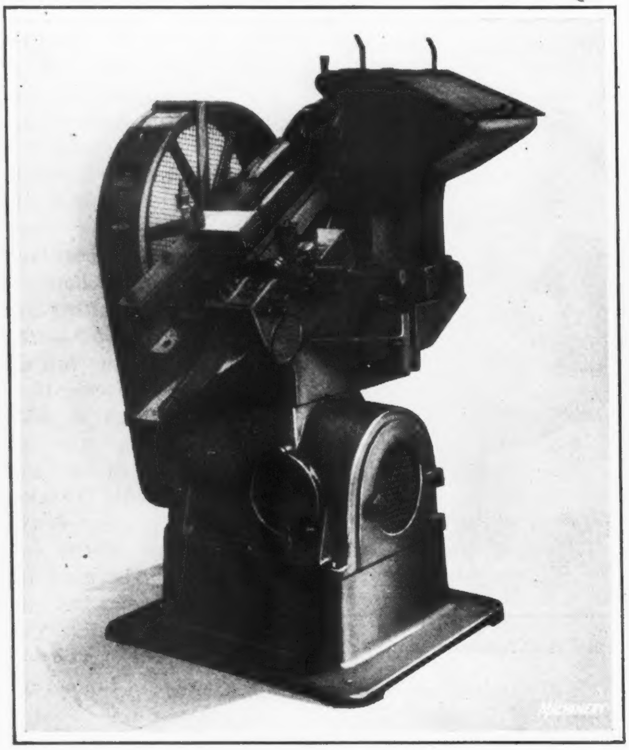


Fig. 4. Reciprocating Screw-thread Rolling Machine furnished with an Enclosed Motor Drive

out which consists of a rod extending into the hollow punch. The production for the three sizes of machines of 5, 7½ and 10 horsepower capacity is said to be 65, 50, and 35 blanks per minute, respectively.

The reciprocating screw-thread rolling machines are built in six sizes for rolling threads on blanks up to ⅝ inch in diameter, and up to 4 inches in threaded length. One of the machines is shown in Fig. 4. The blanks pass from the hopper down an inclined chute to the transfer mechanism, which carries them across to the entrance to the dies. An important feature of the machines is that the transfer mechanism and dies lie in the same angular plane as the feed-chute, which facilitates the setting up and operation.

The hopper is provided with means for correctly locating the blanks in the feed-chute and for assuring an uninterrupted production. Upon reaching the lower end of the chute, the blanks are held by suitable fingers on the transfer slide while they are being carried across to the die opening. The slide is actuated by a spring, but is returned positively by a cam into position for receiving another blank.

The dies are simply rectangular pieces of hardened steel having thread grooves as shown at *A* in Fig. 3. One of the dies is held in a stationary block, while the other is fastened to the gate which reciprocates at the feed-chute angle. The dies can be made of various heights to accommodate the required length of thread. For short threaded lengths, suitable filler plates are employed in the die pockets to locate the dies at the proper height.

When a blank has been transferred to the die opening, a spring pusher bears against the blank to assist in forcing it between the dies at the start of the downward stroke of the gate. The blank is thus pinched between the dies, the thread being rolled on its shank during the downward stroke of the gate. At the end of the stroke the blank drops from the dies into a trough and thence into a suitable receptacle.

These thread rolling machines are built for either a belt drive from a countershaft or with an enclosed motor drive, as illustrated in Fig. 4. The production of the smallest machine is 150 blanks per minute, and of the largest machine 40 blanks per minute.

BESLY HORIZONTAL DISK GRINDER

In the past it has been the general practice to do disk grinding dry, and during this process considerable dust is generated. With a view to overcoming this condition, Charles H. Besly & Co., 120-B N. Clinton St., Chicago, Ill., has brought out a No. 29 belt-driven horizontal disk grinding machine equipped for wet grinding. Although this machine is designed primarily for wet grinding, it can also be used for dry grinding if desired. The inside of the base serves as a large oil reservoir in which the driving pinion and gear run. An opening with an oil-tight cover plate is provided to afford ready access to the internal parts. There is a circular opening under the grinding wheel all the way around, which is used, in dry grinding, as a suction chamber for exhausting the dust, and in wet grinding, as a receiving drain. The machine is shown in Fig. 1 piped for wet grinding, and with the openings for exhausting closed with a removable plate and gasket.

The machine is driven through tight and loose pulleys, the driving shaft running in phosphor-bronze ring-oiling bearings. The outer bearing is supported in a box-pattern pillow-block which is attached to the floor plate, while the inner bearing is carried in a circular split housing attached to the main base. Both bearings have two oil-rings and extra large oil reservoirs. Bevel gearing transmits power from the driving shaft to the wheel-spindle, both pinion and gear being made from steel. The pinion is equipped with a hardened steel thrust collar running against a flange on the phosphor-bronze bearing bushing.

The wheel-spindle is mounted in ball bearings, the lower bearing being assembled in a removable housing fitted into a bored recess in the bottom of the main base. The upper bearing is assembled in a removable housing which is fastened to a circular head plate attached to the top housing. The steel disk wheel is 53 inches in diameter by 1¼ inches thick, and is faced on both sides and grooved to give more

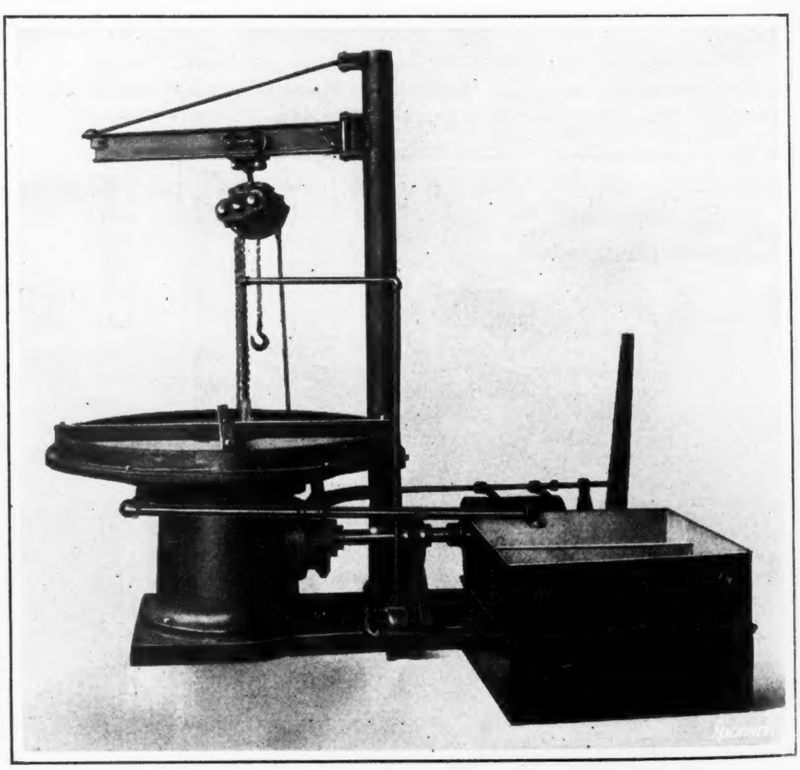


Fig. 1. Besly Horizontal Disk Grinder equipped for Wet Grinding

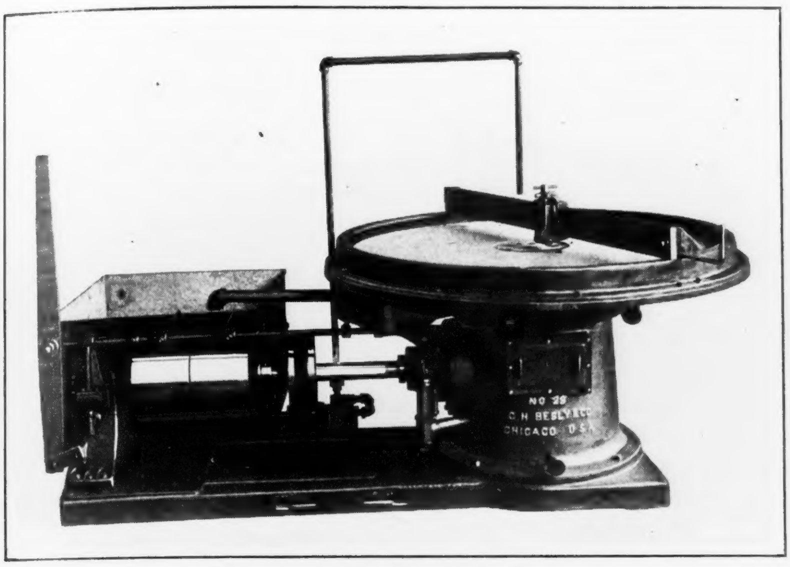


Fig. 2. Grinder with Disk Wheel Truing Device in Place

holding power to the cement used in mounting the abrasive disks. These disks are made in four quadrants, and held to the wheel face with "Helmet" or "Redisc" cement for dry grinding. When the machine is used for wet grinding, "Redisc" waterproof cement is used.

The equipment for wet grinding consists of a circulating pump, piping, and a three-compartment settling tank, as shown in Fig. 1. A guard ring secured to the upper housing collects the water at the outer edge of the disk wheel, and it is then returned to the settling tank. Spacing bars are secured to the guard ring to keep the work from circulating around the disk wheel.

A jib hoist equipped with a traveler and a 1000-pound chain hoist is mounted on one side of the machine, as shown, and used for removing the disk wheel and for handling heavy pieces. It is claimed that on certain classes of work this machine is at least 50 per cent more efficient when used wet, due to the water spreading out over the face of the wheel, and not only keeping the work cool but also preventing the grinding disk from glazing, so that it cuts faster.

Fig. 2 shows the machine with the hoist and spacing bars removed and the disk wheel truing device mounted on the guard ring. This truing device consists of a steel bar supported by two angle brackets. A gibbed cross-slide is mounted on the bar, and traverses the bar from the center to the outer edge of the grinding wheel. The cross-slide, in turn, carries a vertical slide, the lower end of which is equipped with a bronze bearing into which is fitted the dresser cutter spindle. Large-diameter Huntington type cutters are used for truing, and they are clamped rigidly in place on the spindle and impart motion to the spindle itself. The upper end of this slide is provided with a screw for feeding and holding the dressing cutters against the grinding disk. A draw-rod is attached to the lower part of the cross-slide for feeding the cutters across the face of the grinding disk.

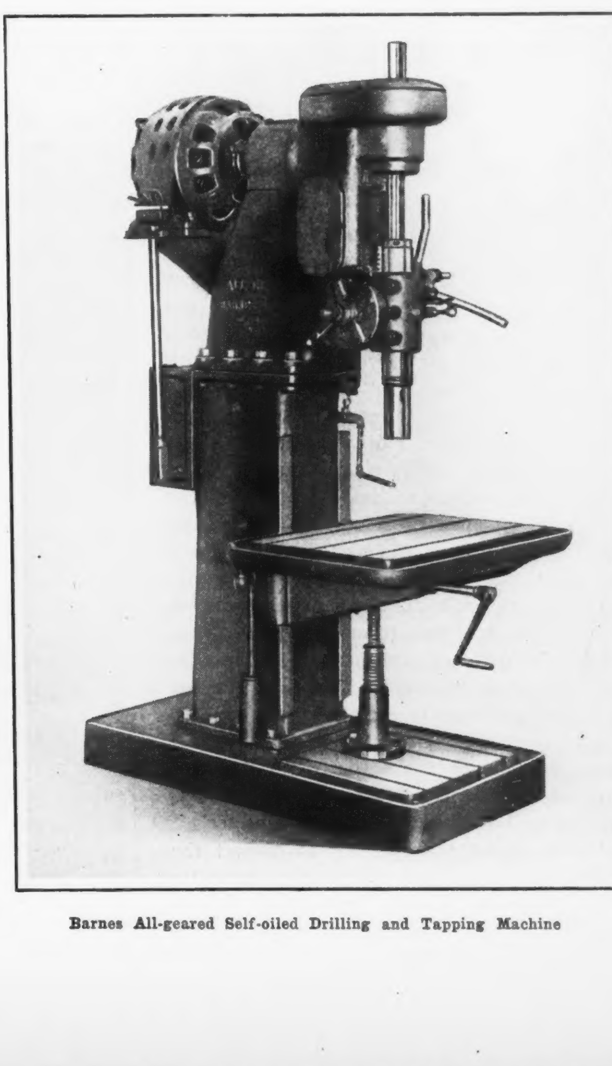
BARNES DRILL CO.'S DRILLING AND TAPPING MACHINE

A multi-purpose drilling and tapping machine that may have a feed and speed set-up to suit any particular job, has been placed on the market by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill. This No. 210 machine is of the all-geared self-oiled design, and is equipped throughout with chrome-nickel steel gears, the most important of which are heat-treated. Any spindle speed from 100 to 2000 revolutions per minute can be obtained, so that all high-speed twist drills from 3/8 to 1 1/2 inches can be used at their maximum working speed in any metal. The speeds are changed by means of take-off crown gears, which may be conveniently interchanged. Likewise, a wide range of feeds is possible through slip gears located on the right-hand side of the machine. Feeds to suit the pitch of taps may be provided for all tapping work. Ten radial ball bearings are provided for the gear-shafts and crown gears, and all the bearings are automatically lubricated.

A particular feature of the machine is the provision of six splines instead of keyways on the spindle, this construction being adopted to prevent binding of the spindle in the crown gear when tapping or doing heavy work. The spindle is equipped with a thrust bearing having a double row of staggered short and long rollers, which is primarily designed to carry heavy loads. The feed gears are all of the spur type, and the power feed may be engaged or disengaged with the spindle running. A patent is pending covering the spur-gear feed.

The column and head construction provides for conveniently using a raising block or substituting a higher column when a greater distance is required between the spindle nose and the table or base. The head is a unit in itself, and contains all the working parts, including the pump for the self-oiling system, but not the coolant pump. The latter is located in the base and driven by a vertical shaft inside the column. Because of the design, the head may be conveniently used in gangs of any number of spindles.

The motor is connected directly to the driving shaft by means of a flexible coupling. A five-horsepower motor running at 1200 revolutions per minute is recommended. A clutch pulley, tight and loose pulleys, or a quick-change gear-box may be provided instead of the motor, and mounted in the same location. The star-wheel handle and internal gear construction of other self-oiled all-geared drilling ma-



Barnes All-geared Self-oiled Drilling and Tapping Machine

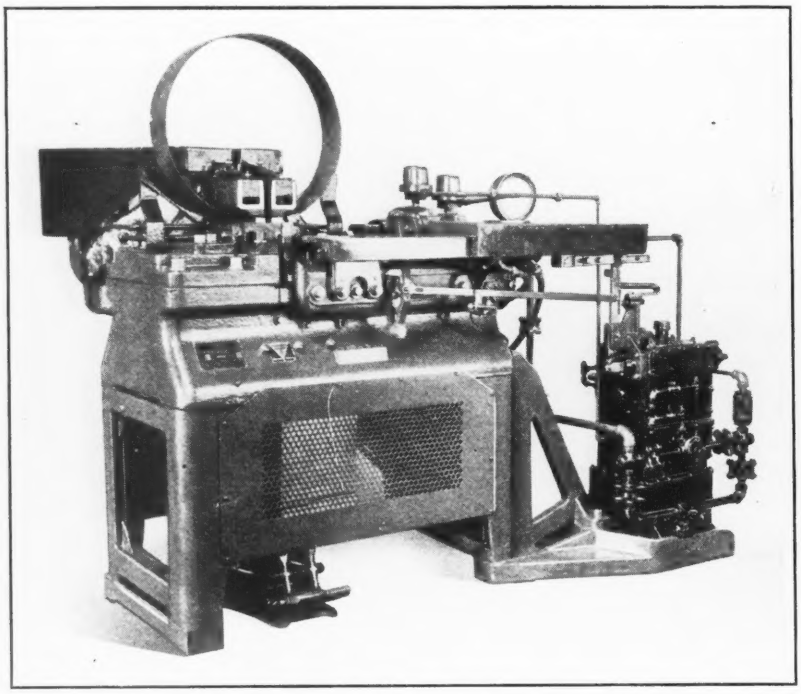


Fig. 1. Thomson Automatic Electric Welder for Automobile Tire Rims

chines built by this company are incorporated in this machine.

Some of the specifications of this machine are as follows: Distance from center of spindle to face of column, 10 5/8 inches; maximum distance from regular table to nose of spindle having a No. 4 taper socket, 27 3/4 inches; maximum distance from base to nose of spindle, 39 1/2 inches; travel of spindle, 12 inches; size of working surface on regular table, 28 by 17 inches; vertical travel of regular table, 17 inches; and weight of machine without motor and starter, approximately 1700 pounds.

THOMSON ELECTRIC WELDING MACHINES

An automatically operated machine for welding automobile tire rims, which is built by the Thomson Electric Welding Co., Lynn, Mass., is illustrated in Fig. 1. This machine, which is known as the Model 45, is equipped with a 150 KVA transformer, and may be furnished for operation on any ordinary commercial alternating current. After the operator places a rim into the clamp of the machine, he presses his foot on a pedal, thus opening an air valve which closes both sides of the clamp and at the same time starts the welding operation. The machine flashes off a predetermined amount, shuts off the current, makes a final push up, and stops. The operator again depresses the foot-pedal to open the clamps for releasing the rim and return the platen to the starting position. The final welding pressure is generated through an oil-gear pump driven either from a lineshaft or a motor.

Considerable modification can be made in the manner of welding in this machine; for instance, two pedals can be used, one for closing each side of the clamp, and an additional hand-lever for actually starting the welding operation. When the machine is set up to be operated in this manner, it not only allows the operator to inspect the clamping of each end of the rim, but also gives him time to move away from the direct line of the flash before he starts the welder in actual operation. In this case, however, as in the first, the clamps are released and the platen returned to the starting position by a second movement of the foot-pedal.

Flat, round, or irregular shaped stock can be handled. Special attention has been given to the design so that particles thrown off from the work cannot get into the moving parts. The welder and oil-gear pump are mounted on a special base that provides a rigid connection between the two. As the time of current flow on the ordinary rim is 2 seconds, an operator can turn out 600 ordinary rims per hour. This is done without scrap because of the automatically controlled current and pressure.

Fig. 2 shows the Model 15 automatic butt welder, which is also built by the same company, equipped for welding the column of pressed-steel pedestals to the base. This particular machine is equipped with a 62 KVA transformer suitable for operating on the usual commercial alternating current lines. The clamp is especially designed for the pedestal which at the point of the weld is approximately 2 1/2 inches in diameter and about 0.075 inch thick. The machine can readily be arranged to handle stock of any ordinary cross-section from 0.1 to 1/2 square inch.

After the parts have been inserted in this welder and clamped by hand, the operator trips a short hand-lever located at the top of the machine to automatically start movements similar to those of the machine shown in Fig. 1. The speed of this machine is only limited by the rapidity with which the operator inserts and removes the parts, the actual time of current flow on the job in question being only about 2 seconds.

ECONOMY BOLT POINTING AND THREADING MACHINE

Bolt blanks ranging from 3/8 to 3/4 inch in diameter and from 1 to 6 inches in length, may be pointed and threaded in a fully automatic machine recently developed by the Economy Engineering Co., Willoughby, Ohio. It is merely necessary to keep the feed hopper filled with blanks, the blanks being carried from the hopper down an inclined

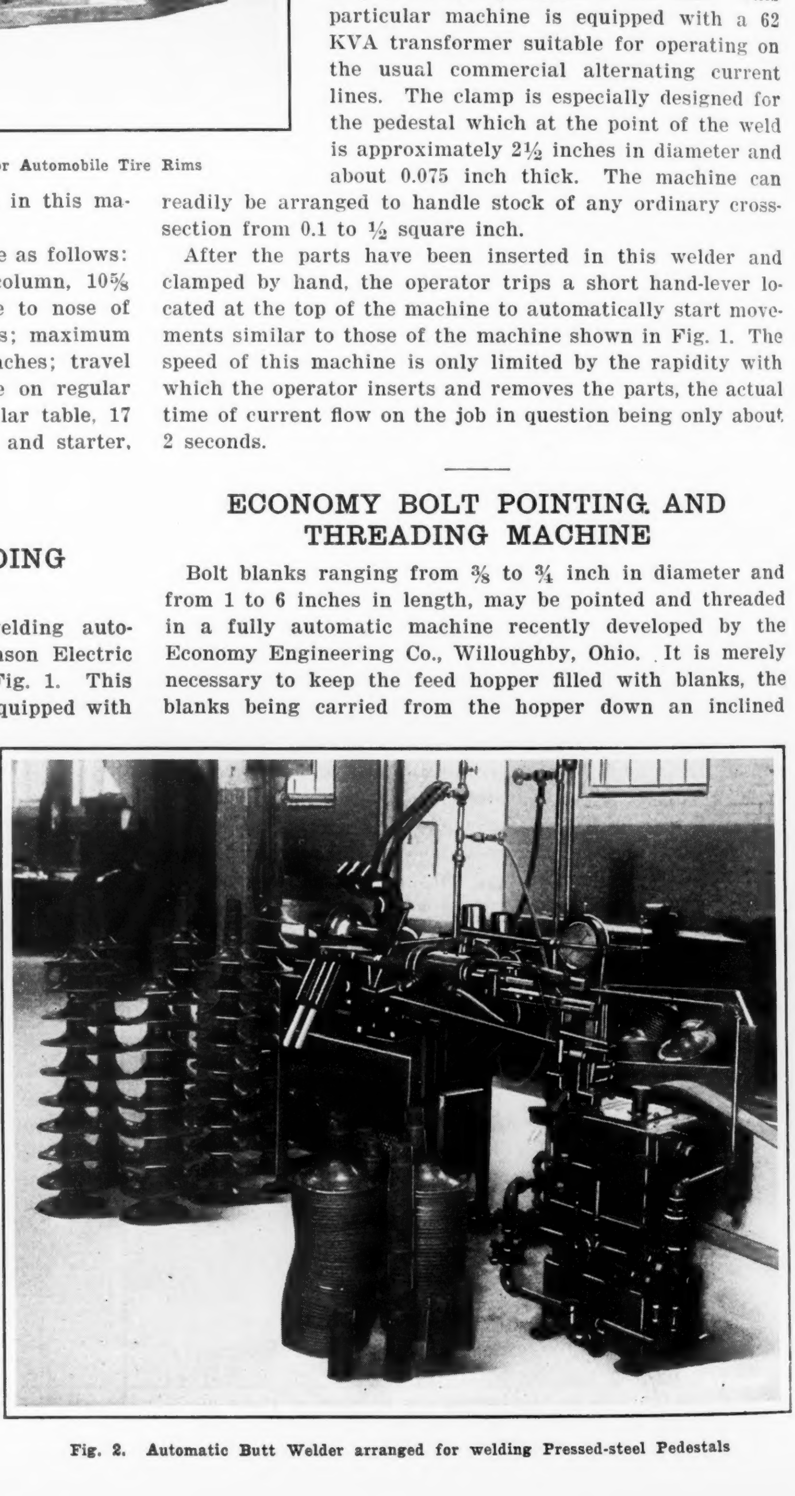


Fig. 2. Automatic Butt Welder arranged for welding Pressed-steel Pedestals

chute and then transferred mechanically to the chuck. There are three stations on the turret, namely, loading, pointing, and threading. When the work has been chucked, the turret is indexed to the pointing station and then to the threading station, after which it returns to the loading position, where the pointed and threaded bolt is dropped from the chuck and a fresh blank substituted. By performing both the pointing and threading operations on a single machine instead of on separate machines, one handling of the work is saved, and savings are also effected in labor and floor space. By way of giving an idea of the productive capacity of this machine, it is stated that in threading 3/4-inch U. S. standard bolts 1 1/4 inches long, the production is 660 bolts per hour.

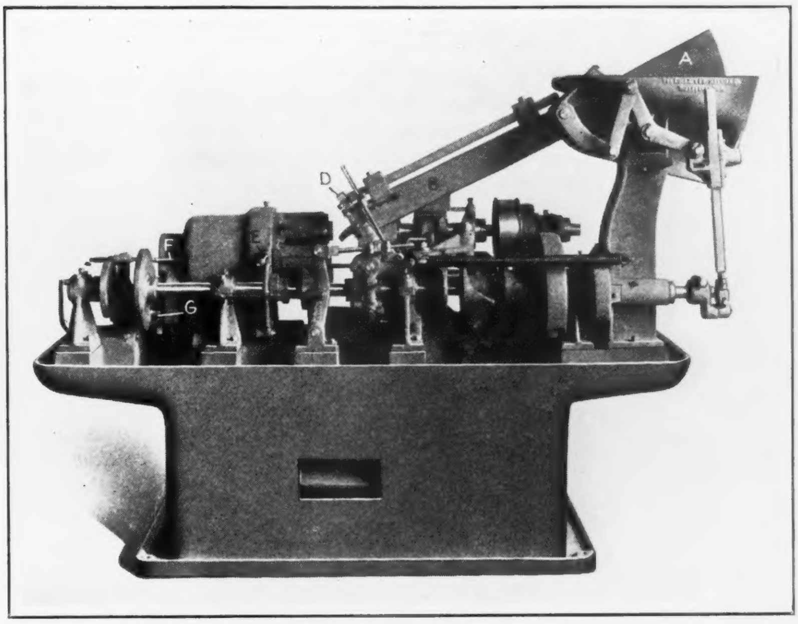


Fig. 2. Opposite View of the Bolt Pointing and Threading Machine

The feed hopper is equipped with the familiar form of double blade *A* which oscillates vertically. As the blade rises, it lifts the bolt blanks lying on it, and at each upward stroke, blanks drop point downward between the blade, the two walls of which are spaced sufficiently far apart to receive the bolt body. The bolt is suspended by its head, which rests on the edges of the double blade. Blade *A* continues its upward stroke until it reaches the position illustrated in Fig. 2, and the blanks carried by it then slide down into the feed chute *B*, which is kept full of blanks because of the continued oscillation of the double blade. On the feed chute there is a cam-actuated escapement or so-called "bolt separator" *C*, Fig. 1, which has two rods that are alternately thrust forward between the bolt blanks in the chute so as to hold back the bolts and yet permit the transfer mechanism to take the bottom blank and carry it to the chuck in the proper sequence.

This transfer mechanism is of the spring-finger type shown at *D*, Fig. 2. It consists of a cam-actuated lever which carries a pair of spring fingers and has two distinct movements, the bolt blank being gripped in the bottom of chute *B*, carried into position above the chuck jaws, and then dropped between them. The chuck is operated by a cam-actuated toggle mechanism which pushes rod *F* forward to open the jaws, and withdraws the rod to close the jaws on the blank. With a fresh blank in place in the chuck, the turret locking bolt *E* is withdrawn, and at the same time cam roller *G* actuates a Geneva movement, indexing the turret one-third of a revolution. This index brings the new blank into place to be operated upon by the pointing head *H*, Fig. 1, and the blank which has previously been pointed, into position to be threaded by die-head *I*. Similarly, the blank just threaded by this die-head is carried to the loading position and dropped from the chuck.

The pointing head is fed to the work by a spring action, and when the operation has been completed, the head is returned against the tension of the spring by means of a cam-operated lever, at the forward end of which there is a yoke having pins that engage the slotted collar *J* on the spindle. Two separate cams produce the successive steps in a cycle of four movements through which the die-head passes in the threading operation. One of these cams closes the die after it has been backed off the preceding piece of work, and then leads it forward to the next blank, while the other cam opens the die after it has completed the threading and returns it to the starting point of the cycle.

The die is also fed forward by spring tension and returned by a positive cam action. Two springs are employed for the forward movement, a strong spring which starts the die on the blank until a stop-screw prevents it from exerting further influence, and a light spring which exerts sufficient force to overcome "drag" of the threading spindle. The construction is said to insure that the die-head will lead itself on the bolt in such a way that a correct thread lead is always secured. Feeding the pointing head and threading die under spring pressure is said to make the machine fool-proof, as in case a bolt of incorrect size becomes accidentally placed in the hopper, the springs will give, and obviate damage to the mechanism.

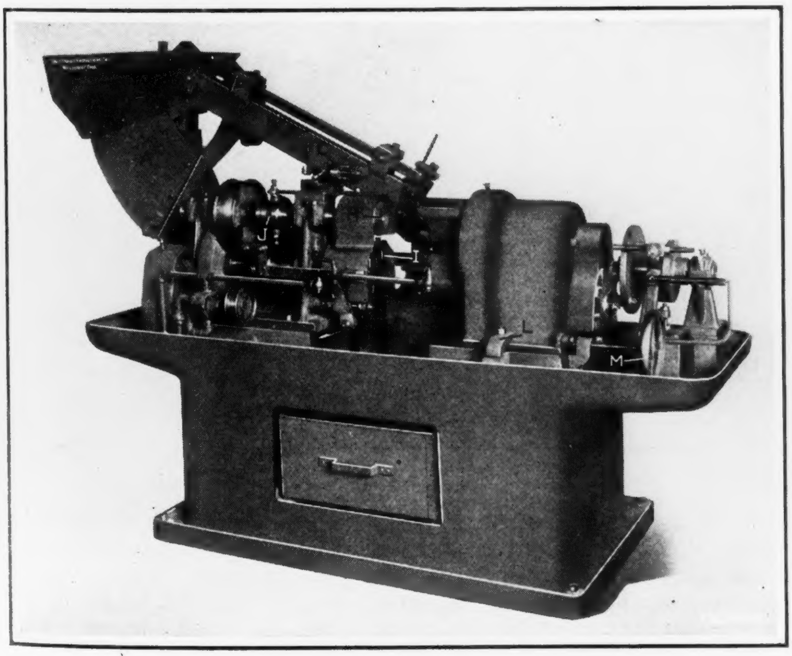


Fig. 1. Economy Bolt Pointing and Threading Machine which is fully Automatic

Change-gears are provided to adapt the machine for handling different classes of work. By changing these gears, the ratio between the camshaft rotation and the work speed may be varied to obtain highest efficiency in threading bolts with different numbers of threads per inch. Provision is also made for changing lead cams to suit the work. In adjusting the machine for different lengths of bolts, the clamps *L* are released and the handwheel *M* is turned to obtain the required setting of the work turret, after which the clamps *L* are tightened again.

FOSTER-JOHNSON SERVICE STATION EQUIPMENT

Several devices intended primarily for use in automobile service stations are being introduced on the market by the Foster-Johnson Reamer Co., Elkhart, Ind. The line consists of a connecting-rod reboring fixture, a connecting-rod bending and straightening vise, a piston aligner, and a surface plate. The connecting-rod reboring fixture, which is illustrated in Fig. 1, is designed with a view to enabling reboring to be accomplished in the minimum amount of time and with maximum accuracy.

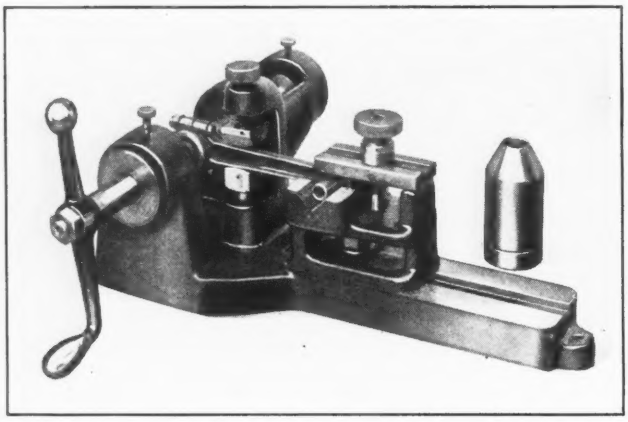


Fig. 1. Foster-Johnson Connecting-rod Reboring Fixture

The wrist-pin is supported by a vee in a saddle that can be adjusted to suit the length of the rod, a clamp holding the wrist-pin end of the rod in place. There is also a V-rest that centers and supports the rod near the opposite or crank-bearing end. A spring permits an up and down movement of this V-rest to suit the rod, a set-screw being finally tightened to bind the rest at the desired height. The clamp mounted directly above this rest is used to lock the rod finally in position. The connecting-rod can be raised or lowered by simply manipulating the screw above the clamp, which makes the adjustment simple and accurate. It is not until after this adjustment has been made that the V-rest is locked by its binder-screw.

The tapered sleeve shown in the illustration is used for centering the crankshaft bearing for the operation. The boring-bar is supported at both ends by bushings and carries a single-point tool. It is revolved by means of a crank and fed forward by a lead-screw having 60 threads per inch. This screw is reversible and may be quickly released from the boring-bar, reversed, and engaged for another cut. Setting the cutting tool to the diameter of the hole is accomplished by measuring over the tool bit and bar with a standard micrometer. The weight of this fixture is about 77 pounds.

At *A* in Fig. 2 is shown the vise furnished for straightening connecting-rods. It will be seen that there is a heavy screw midway between two fixed points on the base, by means of which pressure is exerted on the I-section of the rod. The vise can either be screwed fast to a bench or mounted in an ordinary bench vise. It weighs about 7 pounds.

The piston aligner, which is illustrated at *B*, Fig. 2, is intended for use in fitting new pistons, reconditioning connecting-rod bearings, or installing new wrist-pins. On any of these operations, it is desirable to determine accurately the alignment two ways of the wrist-pin and the main bearing of the connecting-rod. The rod is held on an arbor designed on the principle of the three-point bearing. Two of the points are integral with the arbor, while the third may be expanded to accommodate different sized bearings. The ground ends of the arbor rest in two vees, and are held in place by automatic spring clamps. A push on the arbor brings it into place, and by pulling, it can be released as quickly.

As is clearly shown in Fig. 2, the piston aligning surface is at right angles to the vees that support the arbor. With the piston removed, the alignment of the wrist-pin in the connecting-rod may be checked by means of a square mounted in the groove of the vertical piston aligning surface. This square is adjustable so that the alignment of the wrist-pin can be tested two ways. Reversal of the arbor with the connecting-rod on it may be accomplished almost instantly. Five arbors are supplied to suit crankshaft bearings from $1\frac{1}{4}$ to $2\frac{1}{2}$ inches in diameter. The weight of this aligner, including one arbor, is approximately 42 pounds.

A surface plate for use in testing bearing caps for square, checking camshafts and crankshafts, laying out work, and innumerable other jobs, is also made by this company. The plate can be furnished either plain machined or hand-scraped. It measures 12 by 18 inches and weighs about 40 pounds.

BUFFALO COPING ATTACHMENT

A combination flange and web coping attachment for use on any high-throat punch, shear, or combination machine built by the Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y., has been placed on the market by that company. It should be noted that the attachment cannot be applied to machines having the standard low throat. The attachment will cope or notch channel irons, I-beams, Z-bars, tees, plates, and angle-irons. It is made in a wide range of sizes and capacities, each one having a specified capacity that corresponds to that of the machine with which it is to be used. Six knives are provided for handling webs and flanges, and these are always in place.

A particular feature of the attachment is the self-aligning arrangement of the knives. The upper knife-holder has a machined extension which slides in a corresponding guide in the lower knife-holder. In addition, there are two vertical guide pins rigidly fastened to the lower knife-holder and extending upward into openings in the upper knife-holder. These pins hold the knives in alignment by preventing any shifting or turning of either knife in relation to the others. Adjusting screws are provided for gaging the depth of cut or notching in flanges. Special knives can be furnished for notching to 90 degrees and other angles.

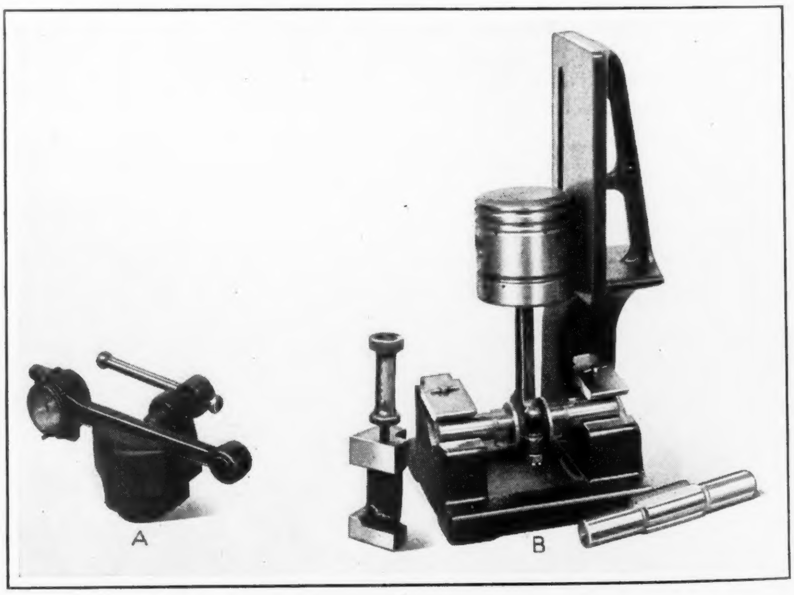


Fig. 2. Connecting-rod Straightening Vise and Piston Aligner

ARTER IN-FEED GRINDING MACHINE

Straight or tapered surfaces on such parts as roller bearings, valve push-rods, pistons, piston-pins, and bushings, that can be held on centering devices, are ground by the in-feed method in a machine recently brought out by the Arter Grinding Machine Co., 72 Commercial St., Worcester, Mass. The machine is entirely automatic except on certain classes of work which it is preferable to load into the feeding turret by hand instead of automatically. In this machine, as the work-carrying turret indexes to the grinding position, centers automatically pick up and drive the work. A frictional force created by spring pressure behind the tailstock center, which is the moving member, is ordinarily the driving medium. However, on such operations as that illustrated, which consists of grinding pistons, an auxiliary work-driver is used, which operates automatically through the headstock center and engages the piston-pin lugs within the piston.

One of the principal features of the machine is the cam action which controls the movements of the wheel-slide, tailstock spindle, turret, work-ejector, and auxiliary work-driver. The driving on the forward stroke is effected in all cases through spring pressure with cams controlling the movement, but on the back stroke, the cams do the driving directly. By utilizing spring pressure in this manner, the possibility of damage should any of the actions become out of time, is reduced to the minimum. Adjustments of the various actions are simple, yet positive, and all are independent of one another.

The number of holes in the turret is as great as the diameter of the work will permit, so as to make the indexing interval short and allow the wheel to function almost constantly. Sufficient clearance is provided in the turret holes to permit the work to revolve freely on the centers. The wheel automatically moves in and grinds the work to size, there being a dwell at the end of the stroke against a positive stop. The successive indexing movements bring the work up to a chute into which it is automatically discharged.

The head and tailstock units are clamped by T-bolts to their seats, which are at an angle and form the upper portion of the bed. The spindles rotate in adjustable bronze bearings, the end thrust being taken by ball bearings. In order to relieve the spindles of all belt pressure and vibration that may be in the drive, they are driven in unison from full-floating pulley units mounted in fixed positions at each end of the bed. The drive to the spindles is through a secondary shaft, which is belt-driven from the main shaft through a cone pulley that furnishes five work speeds.

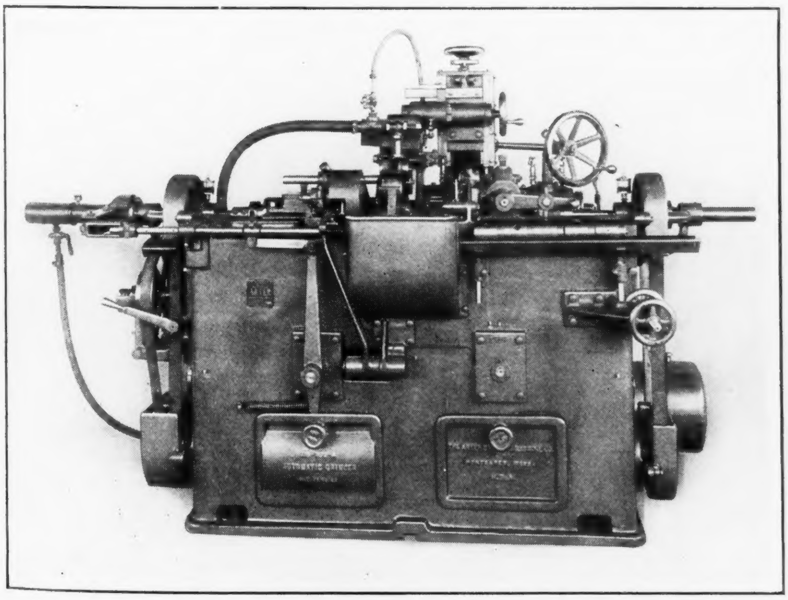


Fig. 1. Arter Automatic Grinding Machine of the In-feed Type

The wheel-head pivots on a base so that the face of the wheel can be swung at any angle with the work up to 5 degrees, graduations and sensitive adjusting screws facilitating accurate settings. The wheel-head is moved to and from the work on one vee and one flat way by a mechanism operated from the camshaft. The camshaft is driven from the secondary shaft through a conical friction clutch and reduction gears. It is possible to disengage the clutch at any time in order to stop the movement of all parts operated from this shaft.

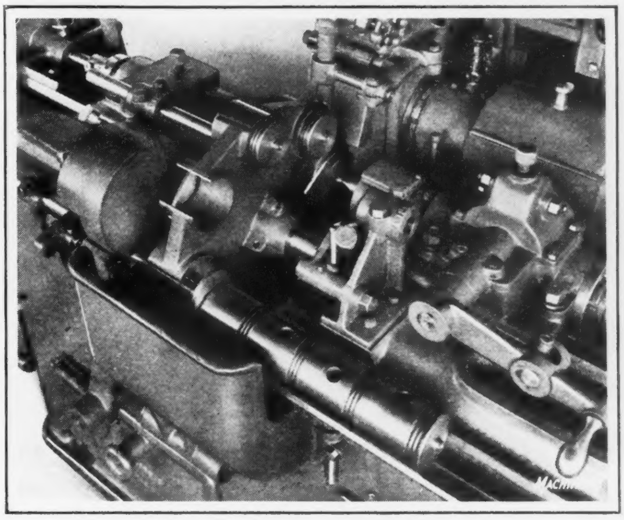


Fig. 2. Grinding Machine shown in Fig. 1, arranged for grinding Pistons

Simple means are provided for accurately adjusting the wheel-spindle in its bearings. It is oscillated longitudinally to eliminate the production of grooves in the work and to insure good running-in. The wheel is located at one end of the spindle to permit quick removal. In order to compensate for wear, it is provided with a handwheel having a micrometer adjustment. The relation of the wheel to the work is maintained without adjusting other automatic movements.

The wheel-dresser is mounted on the wheel-head, and can be used with the work in place without disturbing any arrangement of the machine. The diamond is fed to the wheel by a handwheel with a micrometer adjustment, and the longitudinal travel is also obtained through a handwheel. Lubrication is provided to the spindle continuously by a pump from a reservoir in the wheel-head, through sight drip-feed oilers. A pump of the submerged centrifugal type supplies coolant to the grinding wheel and to the inside of the work when this is desirable.

FOOTE SPEED-REDUCING MECHANISMS

One of the features of the spur-gear speed-reducing mechanisms recently developed by the Foote Bros. Gear & Machine Co., 232-242 N. Curtis St., Chicago, Ill., is that the units are non-planetary. In these machines the power is delivered to a pinion that revolves between three idler gears rigidly journaled to the frame. These idler gears, in turn, transmit power to a large internal gear. When a greater speed reduction is desired, a second pinion may be keyed to the internal gear and engaged with another set of idler gears which, in turn, drive another internal gear. With this method it is possible to secure any reduction ratio by simply increasing the number of gear trains and varying the ratio of the pinions and gears.

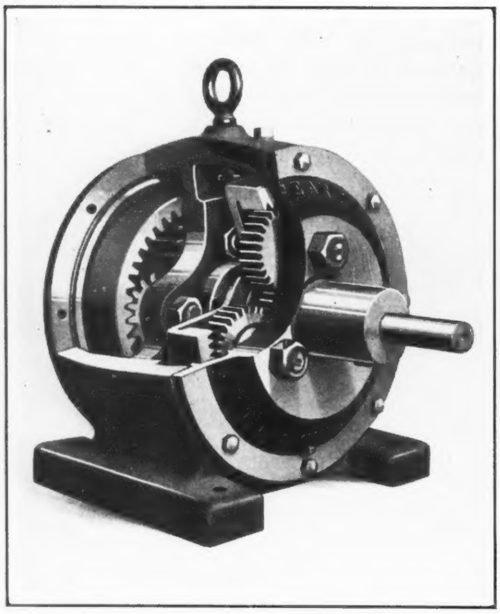
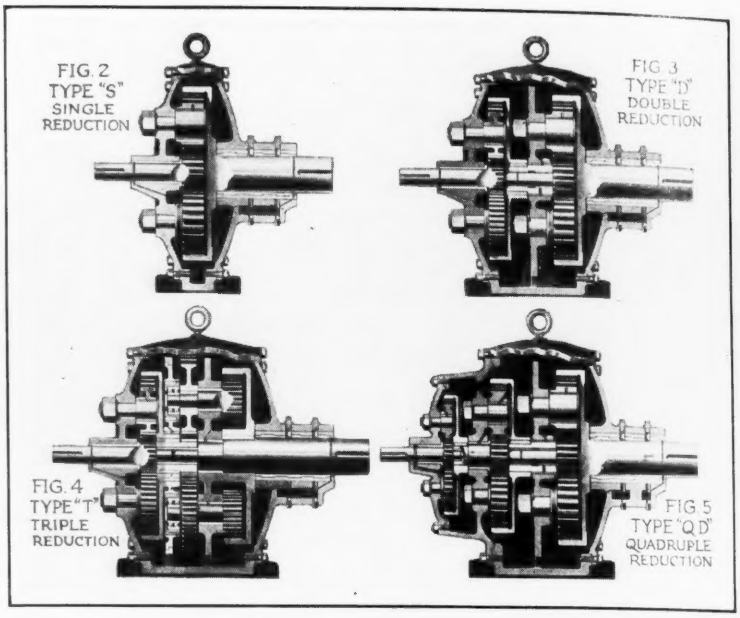


Fig. 1. Foote Double-reduction Speed Mechanism



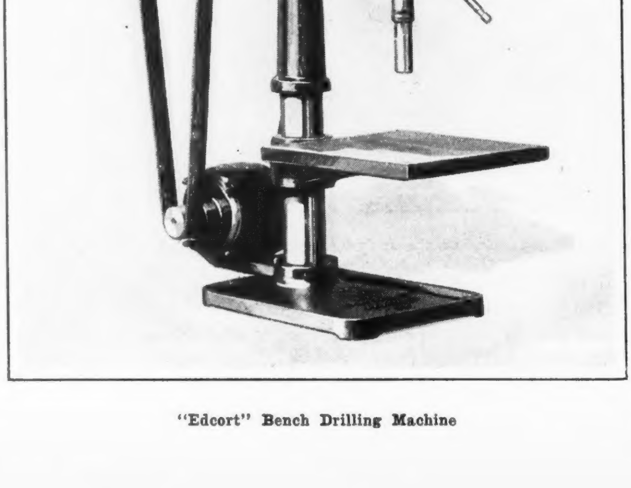
Figs. 2 to 5. Speed-reducers of Single, Double, Triple, and Quadruple Types

Figs. 2 to 5 show the simple construction of units of the single, double, triple, and quadruple type. Any speed reduction between 4 to 1 and 320 to 1 is covered by the different types shown, and reduction ratios as high as 50,000 to 1 may be obtained by combinations of spur- and worm-gear reducers. These speed-reducers are entirely enclosed, so the mechanism may run in oil, and moving parts are not exposed. They may be used in machine shops for driving line-shafts, conveyors, and machine tools, and in automobile plants for driving assembly conveyors; in addition, there are many other applications.

"EDCORT" BENCH DRILLING MACHINE

An "Edcort" No. 2 sensitive drilling machine intended for use in garages, small machine shops, etc., has been brought out by the Edlund Machinery Co., Inc., Cortland, N. Y. The machine may be equipped with or without a motor drive. Power is transmitted from the pulley shaft through two bevel gears and a vertical drive shaft to the rear three-step cone pulley, from which it is carried by a straight endless belt to the front cone pulley that drives the spindle. With a driving pulley speed of 600 revolutions per minute, spindle speeds of 1000, 1400, and 1800 revolutions per minute are available.

The spindle is made of a high-carbon steel and ground to size. This member and the cone pulleys are balanced so as to eliminate vibration at high speed. A small reservoir is provided in the top of the spindle sleeve, which contains sufficient oil so that frequent oiling of the spindle is unnecessary. A weight inside the column counterbalances the spindle, and the latter is provided with a ball thrust bearing at the lower end of its sleeve. The sleeve is reamed on the inside and ground on the outside. The frame and gear-case are cast in one piece to insure alignment. In addition to raising and lowering, the table may be swung around on the column to allow the operator to drill near the edge. The maximum distance from the spindle nose to the table is 11 inches; the vertical traverse of the spindle, 4 inches; the vertical traverse of the table, 7½ inches; the drilling capacity of the machine, ⅜ inch; and the weight of the machine, about 125 pounds.



"Edcort" Bench Drilling Machine

MONARCH ENGINE LATHE

A lathe in which helical gears are used exclusively in the headstock has been recently introduced to the trade by the Monarch Machine Tool Co., 209 Oak St., Sidney, Ohio. The helical gears are used in combination with ball bearings to obtain a quiet-running vibrationless machine. Three and one-half teeth of the gears are always in mesh. Fig. 2 shows the arrangement of this gearing. The driving clutch is of the multiple-disk friction type, and heat-treated chrome nickel steel gears are used. The main spindle is mounted in bronze bearings, the two auxiliary shafts in double-row ball bearings, and ball bearings also take the end thrust developed by the helical gears and the end thrust of the spindle. Eight spindle speeds are obtainable, the gears being always in mesh, so that changes can be conveniently and quietly made with the machine in operation. All spindle speed changes are obtained by manipulating three levers on the headstock, which operate double-jaw clutches. These clutches slide on square sections of the spindle and intermediate shaft. It is said that the use of helical gears permits higher speeds than are practical with spur gears.

Either a headstock or apron control can be supplied for the driving clutch, to give a convenient means of starting and stopping the machine and braking the spindle. There is only one point of adjustment for the clutch, and the adjustment is made from the outside. The motor can be

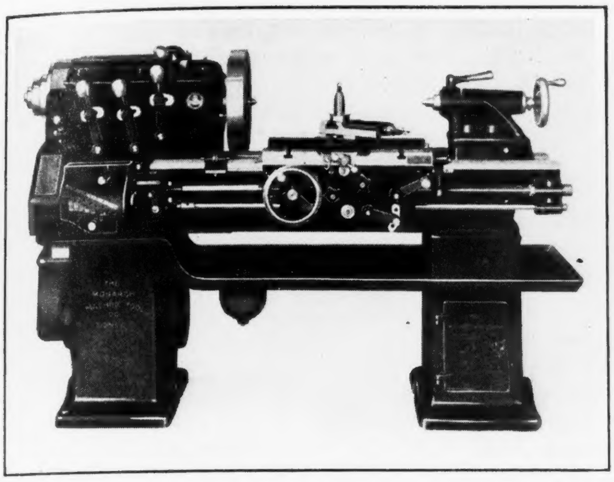


Fig. 1. Monarch Lathe with Helical-geared Ball-bearing Headstock

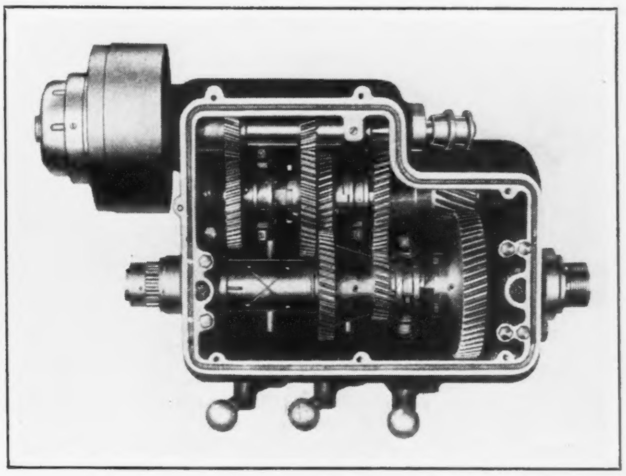


Fig. 2. Arrangement of the Helical-geared Headstock

mounted on the headstock, at the rear of the headstock leg, or inside the leg. The drive from the motor to the multiple-disk clutch may be through an endless belt and over ball-bearing adjustable idlers, or through a silent chain or gears. This machine is built in various sizes from 14 to 30 inches, inclusive.

Another lathe known as the "Super-Production" has also been brought out by the Monarch Machine Tool Co. in 26- and 30-inch sizes. This lathe was developed primarily to meet the need for a machine capable of taking heavy cuts on steel bars and forgings from about 12 to 16 inches in diameter, work of a nature that is frequently handled on heavy lathes of from 30- to 42-inch swing. The 26-inch machine is illustrated in Fig. 3.

Four or eight mechanical speed changes may be obtained through two levers on the front of the headstock, and thirty-two feed changes or thread pitches are available. Either a 20- or 25-horsepower constant-speed or 3-to-1 variable-speed motor can be mounted on the floor at the rear of the headstock or on top of the headstock. The drive is through a silent chain to a large friction-clutch sprocket on the initial driving shaft. This clutch is operated by a lever on the right-hand wing of the apron. As an electrical apron control is also desirable, an additional lever is attached to the apron, which enables the operator to start, stop, or reverse the lathe electrically and, in the case of a variable-speed motor, to secure any spindle speed electrically from the front of the carriage.

The tailstock is of a heavy design, and is held down by four clamping bolts. There is also a rack cast in the center of the bed to help support the tailstock and prevent it from sliding on the bed. The handwheel and rack pinion facilitate moving the tailstock along the bed. Adjustment of the tail-spindle is effected by a pair of miter and spur gears, which bring the handwheel to a convenient position at the front of the tailstock. The cross and longitudinal feed frictions on the apron are operated through ball handles. Any type of toolrest can be furnished, including front and rear blocks which may be operated independently or brought to a common center at the will of the operator. These blocks are provided with automatic diameter stops. Although a geared headstock is recommended, the machine may also be furnished with a two-step cone pulley and double back-gearing. The 26-inch machine with a 10-foot bed weighs about 11,000 pounds, and the 30-inch lathe, about 11,400 pounds.

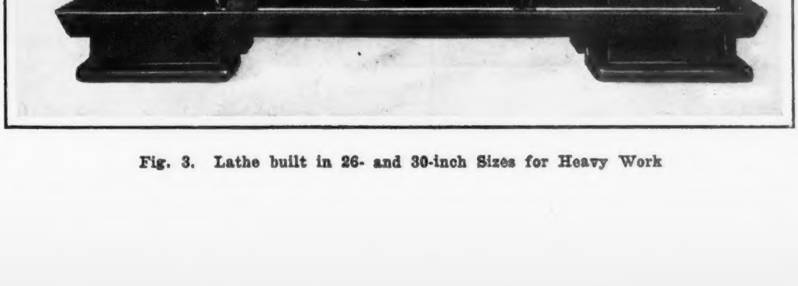


Fig. 3. Lathe built in 26- and 30-inch Sizes for Heavy Work

SOCIETE GENEVOISE GEAR TESTING MACHINE

The pitch, eccentricity, and tooth profile of spur, bevel, and helical gears can be tested on a machine recently brought out by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland. The bed or frame of the machine is designed so that it can be used horizontally for testing the pitch and eccentricity of gears, as shown in Fig. 1, or turned up on end, as in Fig. 2, for measuring the profile.

The gear to be tested is mounted on a mandrel between adjustable centers. Dials and contact pieces for examining the pitch and eccentricity are set on a cross-piece, which can be adjusted along the ways of the bed. The left-hand dial, of the two shown in Fig. 1, has a contact point arranged so that it moves only along a radius of the gear. Thus any variations in the readings indicate the error of eccentricity. The contact point of the other dial is so arranged that it moves tangentially relative to the gear, and hence measures the pitch. The contact points are furnished in four different sizes to measure gears varying in pitch. In testing helical or bevel gears, the two dial indicators may be revolved on their supports so that their connecting levers will be square with the edges of the teeth. When necessary, the effect of eccentricity in the gear upon the readings of pitch variations can be eliminated from the readings of the right-hand dial by a simple calculation.

For checking the shape of the teeth (as in Fig. 2), a disk having a diameter which corresponds to the diameter of the generating circle of the involute teeth under test, is mounted on the mandrel just below the gear. The equivalent of a rack engages the gear teeth while the edge of the disk, in rotating, moves a rolling table. This table is pressed against the disk by a spring, but in other respects can move freely, being mounted on three vertical wheels, with two horizontal wheels bearing against another straight-edge

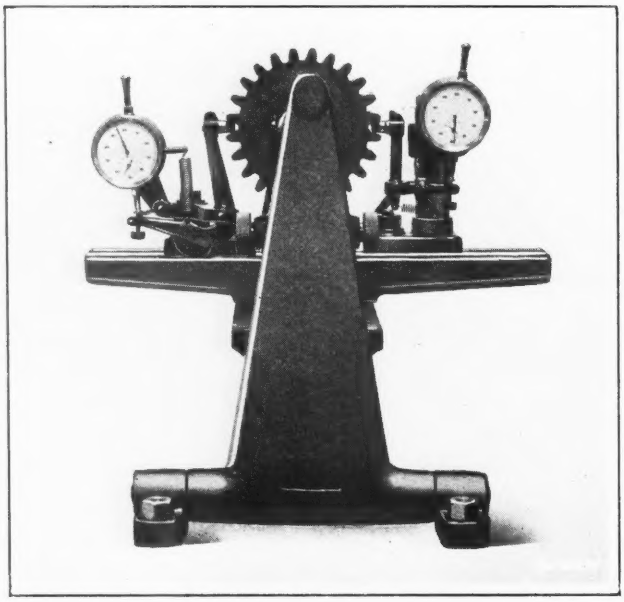


Fig. 1. Gear Testing Machine set up for Measuring the Eccentricity and Pitch of Spur Gears

or bar. The table carries a bracket on which are mounted the rack and the dial indicator which shows any relative motion of the rack and the table, and so measures any variation in the profile of the teeth from the true involute.

The rack consists of a single tooth, which is designed for a pressure angle of 15 degrees, but is mounted on a pivot and can be set by a graduated arc to give other pressure angles, if desired. Both sides of the teeth of the gear may be tested. If, when the gear is rotated, the pointer of the indicator remains motionless throughout the time that the rack tooth is engaged with a gear tooth, the profile is satisfactory. Any variations in the reading of the pointer will show the errors of the profile.

The maximum diameter of gears that can be tested on

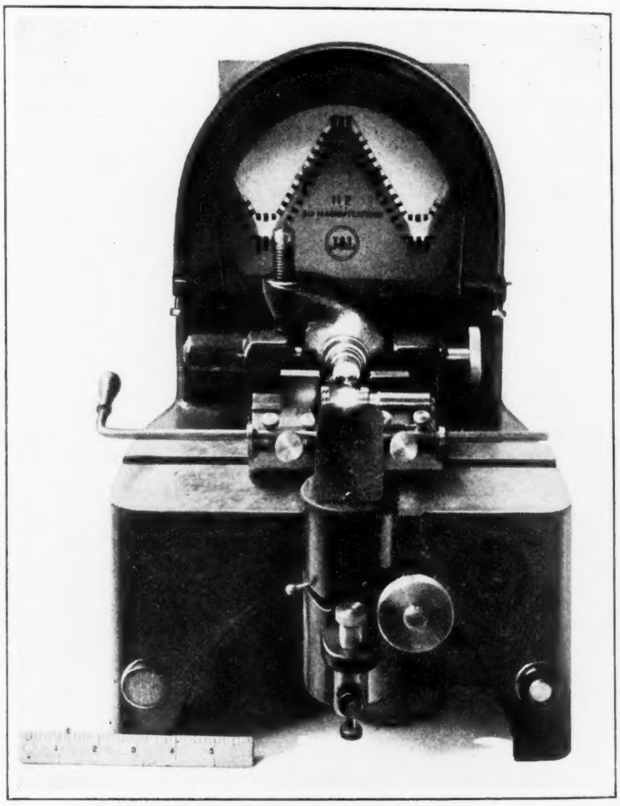
Fig. 2. Machine arranged for testing the Profile of Gear Teeth

this machine is 11¼ inches, and the maximum length of mandrel that can be used is 15¾ inches. The dimensions of the machine are 29½ by 18 by 13½ inches. The net weight is 110 pounds.

The machine is marketed in the United States by the R. Y. Ferner Co., Investment Building, Washington, D. C.

HARTNESS BENCH-TYPE SCREW-THREAD COMPARATOR

A bench-type screw-thread comparator embodying all the essential elements of the standard Hartness comparator (described in January, 1920, MACHINERY) but of smaller size and more compact, is a new development of the Jones & Lamson Machine Co., Springfield, Vt. The bench type machine, like the larger machine, comprises a visual means of simultaneously comparing the pitch diameter, form, and



Hartness Bench Type Screw Thread Comparator

lead of screws or taps with a master, and of determining the extent to which these elements vary from the master.

The equipment consists of two threaded cradles in which the screw to be inspected is held, one of the cradles being fixed and the other free to move endwise to compensate for errors in lead; master gages with which the work is compared; and tolerance charts on which the shadows of the threads, magnified fifty times, are projected for comparison. The instrument is adjusted by placing a master gage in the cradles so that the shadow of the thread directly in front of the lens will coincide with the upper outline on the chart. When the shadow of the thread is projected on the tolerance chart adjusted in this manner, it represents a perfect screw in a perfect nut.

The master gage is then replaced by the screw to be checked. To pass inspection, the shadow of the thread on the screw being tested must fall between the upper (maximum) outline and the lower (minimum) outline on the chart. The space between the maximum and minimum outlines represents the permissible tolerance, which is determined by the class of fit required. If the shadow of the thread is displaced longitudinally, it shows that there is an error in lead. Vertical dis lacement of the shadow represents a variation in pitch diameter. The machine is of con-

venient size to be placed on a bench. It measures 18 inches from the front to the back of the base. The inspector sits directly in front of the machine, and the outline is projected on the chart at a distance of approximately 15 inches from his eyes.

SHORE SWINGING-ARM SCLEROSCOPE AND AUTOMATIC ACTUATOR

A scleroscope having a tilting base and a swinging arm, both of which may be clamped in different settings, is now made by the Shore Instrument & Mfg. Co., Van Wyck Ave., and Carll St., Jamaica, N. Y. This outfit, which is illustrated in Fig. 1, is non-portable. Work of greater size can be accommodated than with the standard portable scleroscope, and odd-shaped pieces can be conveniently handled. The heavy tilting table is graduated to facilitate setting to any angle in order to bring work of various shapes into the most convenient position for testing. There is a large

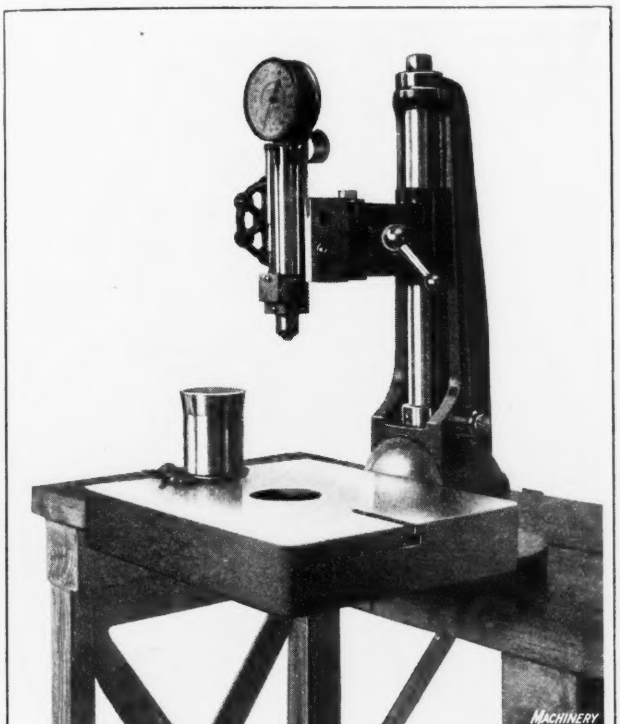


Fig. 1. Shore Non-portable Scleroscope Outfit with Swinging Arm and Tilting Table

center anvil that is removable to enable long specimens to extend through the table. The swinging arm is mounted in ball bearings, and is rigid enough to permit clamping down specimens. It can be set in any lateral or vertical position, and has an elastic return to the lateral setting. This arrangement eliminates the necessity for special holding fixtures otherwise required for testing odd-shaped pieces in quantities. The scleroscope itself is the same as is furnished in the portable set, and is interchangeable in both sets.

When the operator is required to make several thousand scleroscopic tests per day, the continuous effort is fatiguing. Hence there has been a demand for an auxiliary actuating device that will relieve the operator of muscular effort. An electro-pneumatic machine designed for this purpose is shown at the right in Fig. 2, connected by a rubber tube to a vertical-scale scleroscope at the left. A controller valve is located at *A*.

To operate the equipment, the workman puts one of his fingers through ring *B*, and depresses the trigger valve *C* with another finger of the same hand. By this arrangement a succession of tests can be made by merely holding the trigger down. The actuator has the same suction and compressive force as the operator would have with the usual rubber bulb, and it runs at a suitable speed for operating

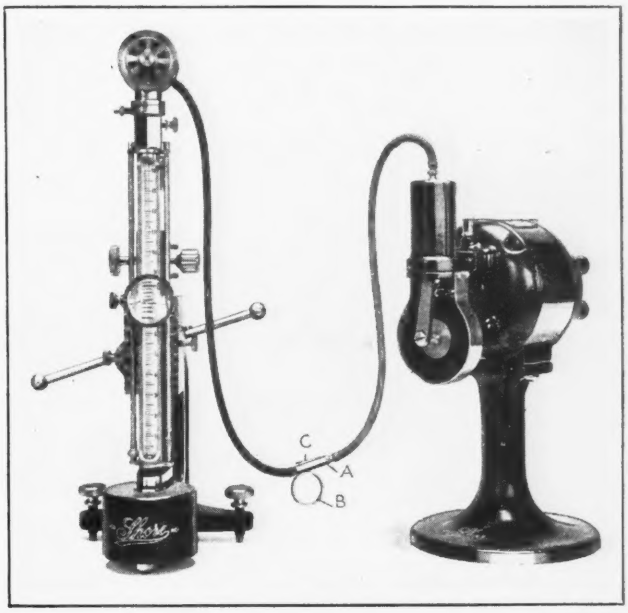
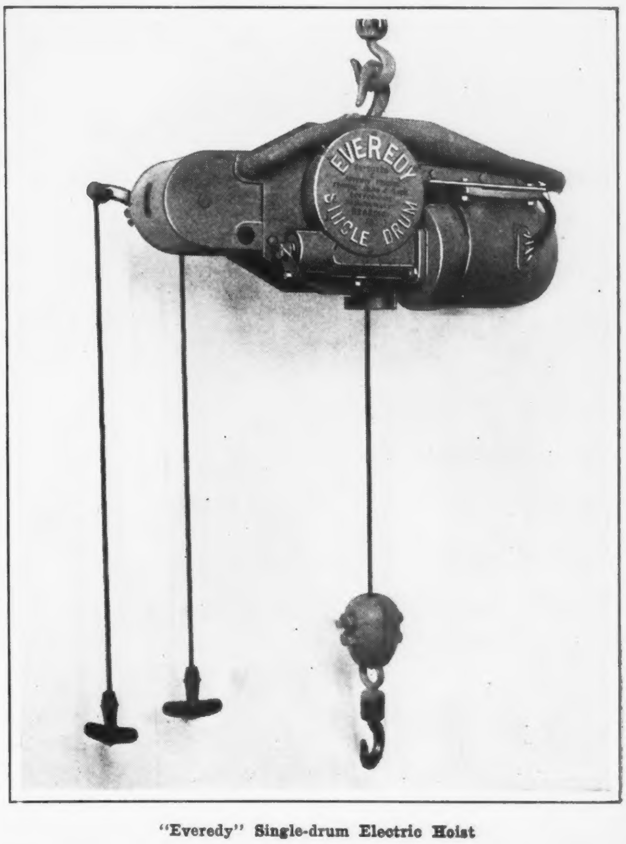


Fig. 2. "Sico" Automatic Actuator for operating the Model C-1 Scleroscope

the scleroscope in ordinary service. The timing for drawing up the hammer and for the release and rebound is governed automatically by a slow-speed motor, and is so calculated that following each rebound the hammer is drawn up before it can fall back on the test specimen a second time.

"EVEREDY" ELECTRIC HOIST

An "Everedy" single-drum portable hoist has been added to the double-drum models made by the Reading Chain & Block Corporation, Reading, Pa. The new hoist is made in various sizes for handling loads from 500 to 2000 pounds. A feature of the hoist is its lightness, the 500-pound hoist weighing only 215 pounds. It will lift its rated load at a speed of 41 feet per minute with alternating current, or 33 feet per minute with direct current. The standard lift



"Everedy" Single-drum Electric Hoist

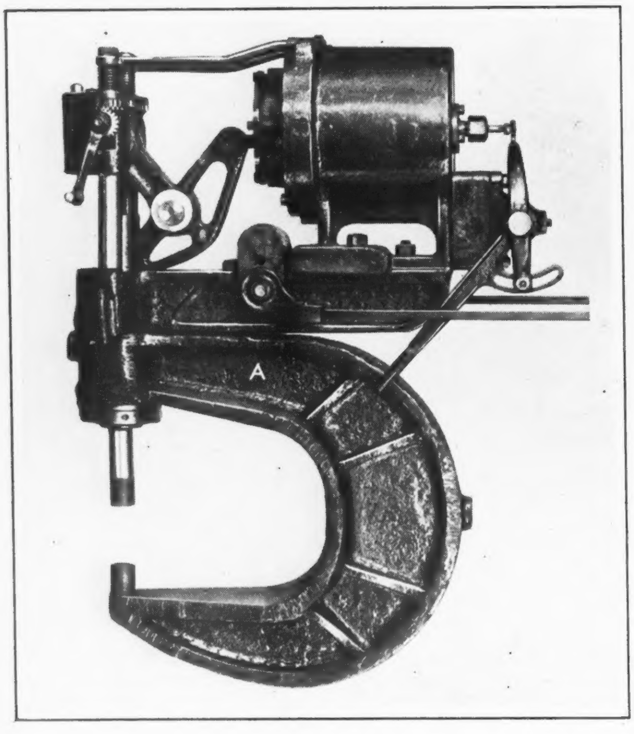
is 15 feet, but longer lifts can be arranged for. Two other features pointed out for the hoist are the accessibility of the few moving parts and the low head-room required. It is equipped with roller bearings throughout and with the "Alemite" lubrication system. The drum is deep-grooved to prevent the rope from pulling up or over-winding.

HANNA SPECIAL COLUMN RIVETER

A special column riveter in which the frame can be swung around a circle relative to the remainder of the equipment so as to facilitate certain operations, has been placed on the market by the Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. By rotating the frame *A*, 180 degrees from the position shown, the riveter can be used to work clear across the stiffening angles of the web of a girder on edge. This means that the reach is twice as deep as it would be without revolving the frame, turning over the girder, or dropping the machine. Furthermore, cover plates can be riveted to girders laid on their sides, the rivets being driven through both the upper and lower legs, without turning the girder over or dropping the machine. Two frames are made for mounting on one head, that shown having an 18-inch reach and a 16-inch gap, and the other, a 9-inch reach and a 12-inch gap. The equipment will drive 7/8-inch structural rivets.

The riveter is equipped with a plain toggle mechanism of which the inner toggle is extended for attaching to the piston-rod. The outer toggles pivot at their outer ends in a nut block which is adjustable in and out on two strain rods; the strain rods, in turn, are mounted in the head casting that carries the cylinder. At the inner end, the inner toggle pivots in a plunger that is free to slide in the head casting. In the other end of the plunger, the movable rivet die is mounted. The strain yoke or frame is bored at the end of one leg to fit over a journal turned on the head casting. This journal is concentric with the axis of the plunger and die. Since the hole in the other end of the frame leg is concentric with the journal on which the frame rotates, this rotation does not affect die alignment.

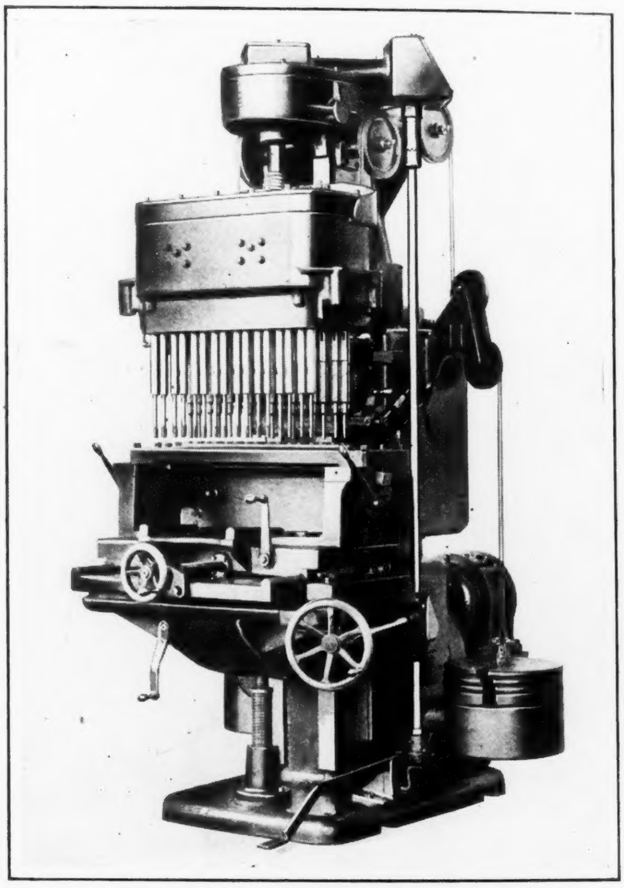
Pressure between the rivet dies tends to pull the frame off the head journal. This force is taken on a nut screwed on the journal outside of the frame bore. The nut may also be used to lock the frame in a given position on the head. Adjustment of the gap between the dies is made by screwing the nut block in or out on the strain rods. This is done by turning the hand-crank. The operating valve is of the four-way slide D type. At the end of the return stroke, the piston forces the valve into the neutral or "off" position through a device that saves air. Equipped with the large frame, the riveter weighs about 1573 pounds, and equipped with the small frame, about 1465 pounds.



Hanna Riveter equipped with a Rotatable Frame that greatly increases the Range of Work

DEFIANCE FIXED-CENTER MULTIPLE-SPINDLE MACHINE

A fixed-center multiple-spindle machine recently built by the Defiance Machine Works, Defiance, Ohio, for boring, reaming, counterboring, and spot-facing the valve holes in automobile cylinder blocks, is shown in the accompanying illustration. The machine is fitted with a thirty-two spindle head, but any number of spindles can be provided to suit requirements. The machine can also be equipped with a head in which adjustable spindles are arranged in a straight line, with a maximum center distance between spindles of 30 inches and a minimum distance of 2 inches. Large weights are used to counterbalance the head.



Defiance Multiple-spindle Machine for finishing the Valve Holes of Cylinder Blocks

The feed mechanism is driven from the drive shaft through hardened steel gears. It contains both friction and hardened jaw clutches which are immersed in oil. End thrust is taken by ball bearings. Both a power and hand feed are supplied, together with a rapid traverse. The table can be furnished in either a knee or box type, and it is adjustable vertically. This adjustment is obtained by turning a crank-lever, which, through a spiral gear mechanism, actuates a heavy jack-screw. The box-type table is provided with T-slots on the top surface to which work or a jig may be clamped. The head, feed and speed box are built as separate units, entirely independent of one another. and can be readily removed for inspection.

Oiling is accomplished by means of a combined force feed, gravity flow, and splash system. The speed and feed mech-

anisms, taken collectively, and the spindle head, separately, are provided with independent and self-contained oiling systems to insure adequate lubrication. Equipment for supplying cutting compounds to the tools and work can also be furnished. The machine weighs about 11,350 pounds.

WATSON-STILLMAN COMBINATION PRESS

A 60-ton hydraulically operated combination press which may be used either vertically or horizontally for a variety of bending, forcing, straightening, and similar operations, has recently been produced by the Watson-Stillman Co., 192 Fulton St., New York City. This machine comprises a pipe-bender, shaft-straightener, die-sinking and upsetting press, vertical forcing press, small hand arbor press, horizontal forcing press, and horizontal forming and bending press.

Fig. 1 shows the arrangement of the machine when it is set up in the vertical position. It is converted into a horizontal press, as shown in Fig. 2, by simply rotating the handwheel. The press is so balanced that the change from the vertical to the horizontal position may be made without the assistance of a crane or jack. The bed of the press is planed smooth for supporting the forming tool on the lower end of the ram when the press is used in the horizontal position. For forcing long shafts, the abutment beam may be moved out a maximum of 7 feet from the ram as shown, a four-wheeled truck being provided to support the beam in the extended position.

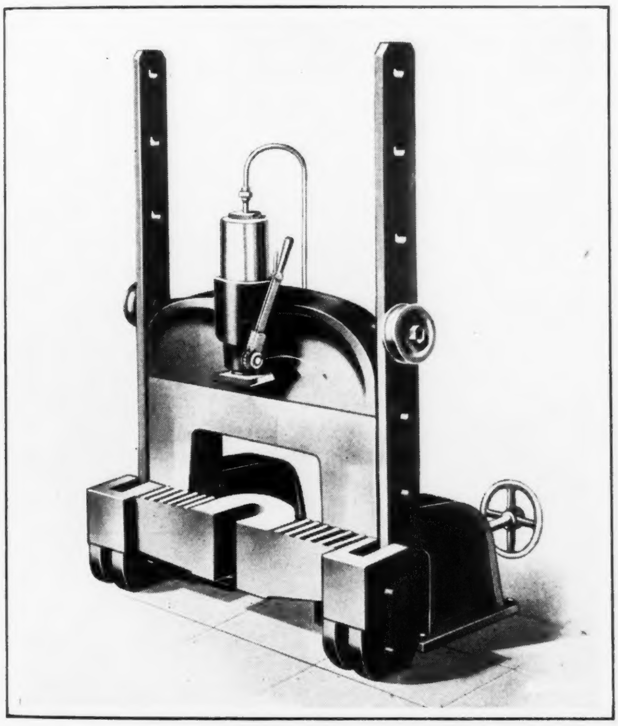


Fig. 1. Watson-Stillman Hydraulic Press in Vertical Position

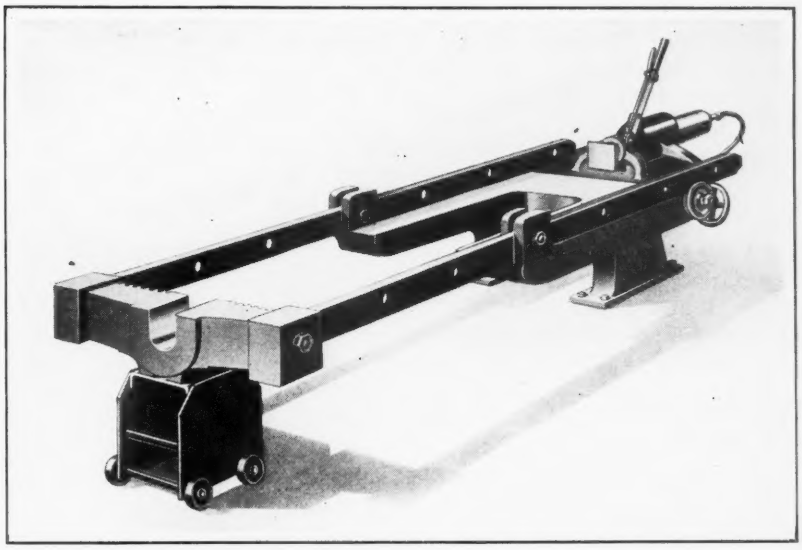


Fig. 2. Press in Horizontal Position with Abutment Beam extended

Hydraulic pressure is used only for the high-pressure portion of the ram stroke. The idle portion of the forward stroke and the return movement is effected by means of a pinion which meshes with the teeth of a rack in the ram. This rack and pinion device is of sufficient power to operate the press for light arbor work without using the hydraulic equipment. A hand pump, complete with a hydraulic gage, pipe, and connections, is usually furnished. The press may also be operated by a small two-plunger power pump. Several of the important dimensions of this machine are as follows: Stroke of ram, 10 inches; maximum vertical opening, 18 inches; maximum horizontal opening, 84 inches; distance between bars, 36 inches; and depth of gap in beam, 4¼ inches. The weight of this press is approximately 3700 pounds.

MEACHEM SPEED-REDUCER

In using high-speed turbines and motors for driving low-speed machinery, such as compressors, generators, refrigerating machines, pumps, conveyors, crushers, etc., it is, of course, necessary to use a speed-reducing mechanism. To meet the requirements of this class of service, the speed-reducer shown in the accompanying illustration has been brought out by the Meachem Gear Corporation, 122-142 Dickerson St., Syracuse, N. Y.

In this mechanism the load is transmitted from the high-speed shaft through planetary gears to a slower rotating annular ring. Inside this ring are a number of rockers which engage a spider keyed to the low-speed shaft. As the driving motor or turbine starts, each of the rockers engaging the teeth of the spider compresses a spring plunger, which brings the bottom of the rocker into contact with the inside of the annular ring, and at the same time brings one side of the ring into contact with the side of the adjacent spider tooth. During the time required to compress the spring plungers, which corresponds to about one-fourth of a revolution, there is practically no load on the turbine

Meachem Speed-reducer

or motor. It is said that no shock exists with this equipment and that the spring plungers eliminate vibration and backlash. The low-speed shaft to which the spider is keyed is supported on both sides of the spider. The pinion on the high-speed shaft is allowed to float and adjust itself to the proper position between the planetary gears, thus preventing side strains or unequal stresses.

The speed-reducer is totally enclosed, making it dust-proof, and all parts run in oil, forced lubrication being provided for speeds above 1800 revolutions per minute. The device can be applied to either step-up or step-down speeds, and is furnished in ratios of from 4 to 1 to 200 to 1, and for any load up to 500 horsepower.

AMERICAN BROACH AND ASSEMBLING PRESS

An improved power broach and assembling press equipped with automatic stops and a friction clutch for controlling the ram movements, has recently been brought out by the American Broach & Machine Co., Ann Arbor, Mich. Small parts are broached in this machine by the push method. It is intended that the machine be mounted on a bench or on a pedestal which can be furnished. Power is transmitted through a steel worm and bronze gear, which run in grease.

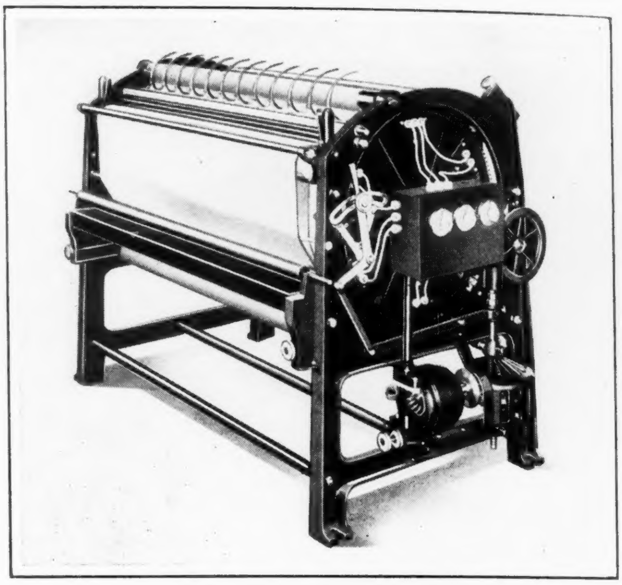
American Improved Broach and Assembling Press

The maximum stroke of the machine is 14 inches, and the maximum distance from the top of the table to the end of the ram is the same. Work up to 6 inches in diameter can be handled. There is a $2\frac{1}{2}$-inch bore at the center of the table for which a reducing bushing is supplied. A pressure of about 2 tons is developed in this equipment. The weight of the machine is about 200 pounds.

PARAGON BLUEPRINT DRYING MACHINE

A machine for drying blueprints and photostats, known as the "Jumbo," has been placed on the market by the Paragon Machine Co., 503 Engineering Bldg., Rochester, N. Y. This machine dries prints at a speed ranging from 8 to 14 lineal feet per minute. It is made in two sizes, of 42 and 54 inches. The larger size, running at maximum capacity, will dry 2000 square feet of prints per hour. The machine may be heated by either gas or electricity.

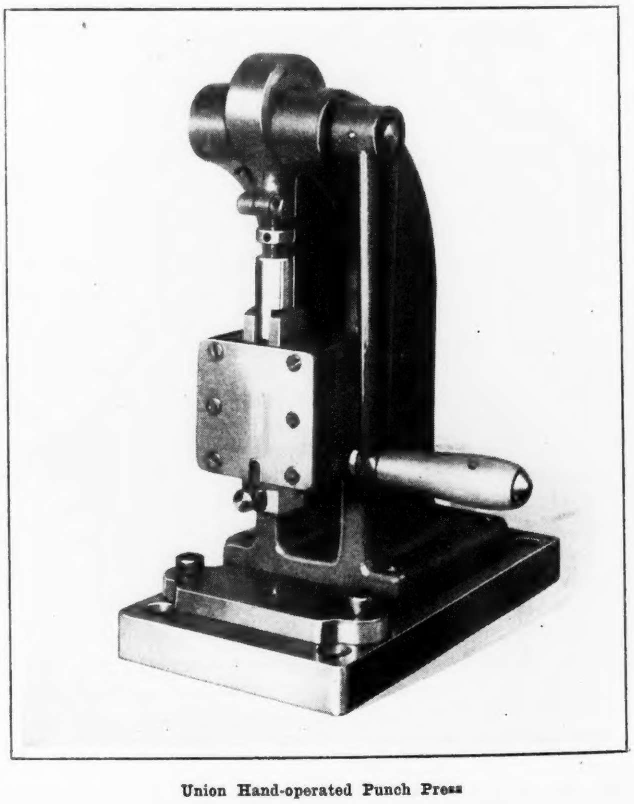
The drying process is continuous, the paper being carried on a canvas belt around a cylindrical heated drum 6 feet in circumference. The surface with which the wet prints come in contact in one revolution of the 54-inch machine is more than 25 square feet, and on the 42-inch machine, more than 20 square feet. As a result, the dried prints can be turned out at unusual speed without resorting to excessive heat. The prints are delivered at the back of the machine out of the operator's way where they can be conveniently trimmed.



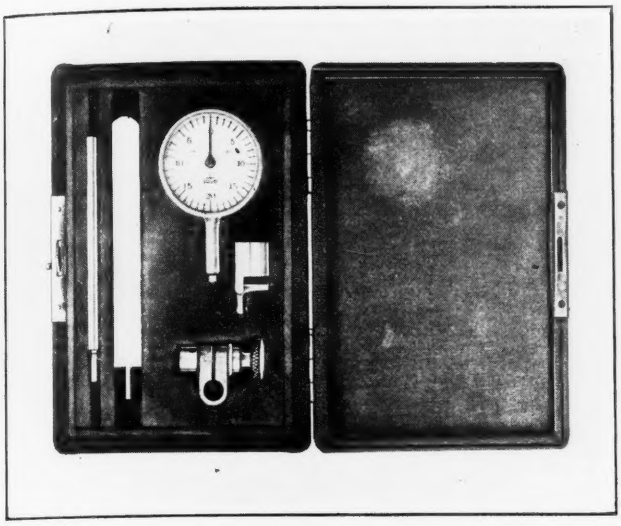
Paragon Machine for drying Blueprints and Photostats

UNION HAND-OPERATED PUNCH PRESS

A small hand-operated punch press has been added to the line of products made by the Union Tool Co., 299 Norton St., Rochester, N. Y. The press is suitable for small forming, perforating, and blanking jobs. It is $13\frac{1}{2}$ inches high, and has a maximum die space of $2\frac{1}{8}$ inches, with an adjustment of $1\frac{1}{8}$ inches. The weight is 46 pounds. A spring tempered pin, 3/16 inch in diameter by 3 inches long, is furnished as a wrench. It is said that this hand-operated machine can be operated faster than a foot press, and with practically no hazard to the operator.



Union Hand-operated Punch Press



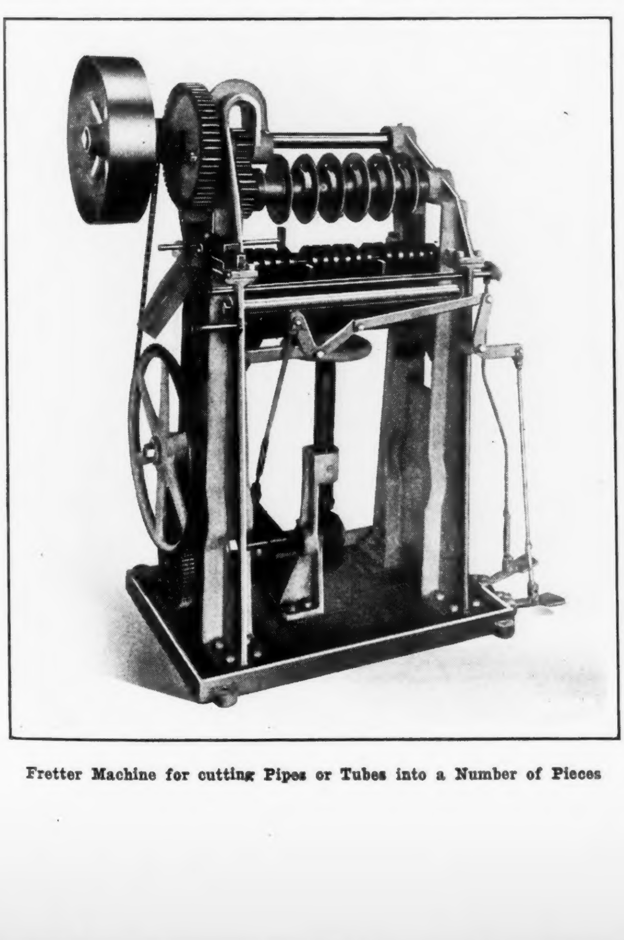
Federal Indicator Gage and Attachments

FEDERAL INDICATOR GAGE

A light and sensitive dial indicator with attachments that enable the user to adjust it quickly to any desired position on a surface or on a height gage, is the latest indicator added to the line manufactured by the Federal Products Corporation, 15 Elbow St., Providence, R. I. This model 25 indicator is intended for checking work in lathes, milling machines, grinders, shapers, or planers. The diameter of the dial is only 1 inch. It is graduated in thousandths of an inch, a complete revolution of the hand giving the full range, which is 0.040 inch. As illustrated, the indicator is furnished in a small leather case which can be carried comfortably in the pocket.

FRETTER TUBE-CUTTING MACHINE

A machine that cuts pipe or tubing into a number of pieces in one operation by bringing the stock into contact with rotary cutters, is built by the Leonard Machine Works, Baltimore Ave. and Hirst St., Lansdowne, Pa. As shown in the illustration, the cutters are mounted adjustably on a horizontal shaft which is driven through a pulley and double back-gearing. On the table beneath the cutters, there is a dovetail groove in which rests may be positioned to support the tube to be cut. After the work has been slipped in place on the rests against a stop controlled by a foot-treadle, the table is raised to bring the tube into contact with the cutters. The raising of the table is accomplished by means of a cam mounted on the shaft at the bottom of the machine, which is rotated one revolution through a clutch operated by a second foot-treadle. The cut pieces of tube are pushed off the machine when a new tube is inserted.

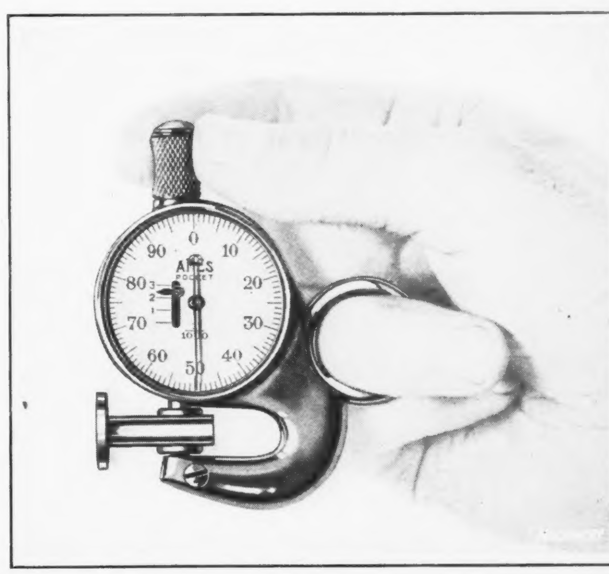


Fretter Machine for cutting Pipes or Tubes into a Number of Pieces

Sharpening of the cutters can be accomplished while they rotate in the machine, by employing an electric grinder. The height of the table is adjustable to suit the diameter of the tube and wear of the cutters, by turning the hand-wheel at the top of the plunger-rod which bears against the under side of the table. The shaft at the bottom of the machine is driven from the main drive at the top through spur and chain gearing. Long bearing surfaces at each end of the table fit the upright housings and allow the table to work freely up and down. Tubes having an outside diameter up to 2½ inches and a wall thickness up to 3/16 inch can be cut in this machine.

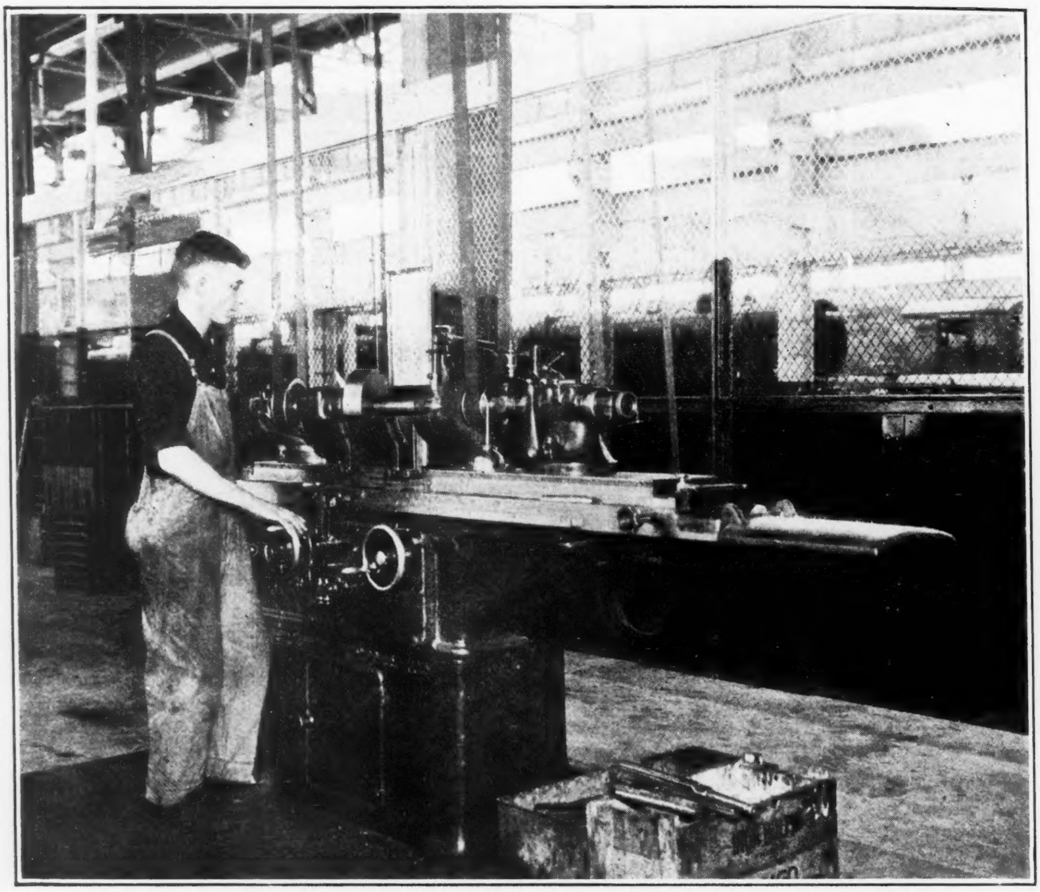
AMES POCKET THICKNESS GAGE

A small compact thickness gage, reading in thousandths of an inch, for measuring flat or round materials up to 5/16 inch thick, which fits easily into the vest pocket, has been added to the line of micrometer dial gages manufactured by the B. C. Ames Co., Waltham, Mass. The dial face is 1½ inches in diameter, and the weight of the gage only 5 ounces. The frame is made of solid bronze and finished in nickel. A ring is attached to the frame through which a finger may be inserted to hold the gage while the thumb and forefinger of the same hand are used to operate the knurled screw at the top of the spindle to open and close the jaws.



Ames Pocket Thickness Gage

The bottom jaw is adjustable in the frame to set the large pointer to zero on the dial face, but otherwise it is stationary. The top jaw is securely attached to the movable spindle. Thousandths of an inch are recorded by the large pointer, while the number of revolutions made by this pointer are recorded by the small pointer. A dial inserted at the back of the gage gives decimal equivalents for fractions of an inch. Hence, readings in decimal sizes taken with the graduated dial on front, can be conveniently transposed into fractional sizes by referring to the dial on the back. Unbreakable crystals protect both the front and rear dials, and all parts are replaceable in case of damage.



Are Your Grinding Machines Adaptable?

B·S
TRADE MARK

Universal Grinding Machines

In the tool-room Brown & Sharpe Universal Grinding Machines have built up a fine reputation and now they are proving, daily, that their adaptability to different classes of work make their installation a paying proposition on production jobs.

A good example of the versatility of these Universal Grinding Machines is shown in the above illustration. This machine is working for one of the big railroad systems and is called upon to do many different jobs. First, cylindrical grinding, then an internal job or tapered pieces—it doesn't matter which—all such work is handled with equal accuracy and economy.

Isn't this the kind of equipment you need? Adaptable machines—machines which can be used on a wide variety of work.

Catalog No. 137 gives complete details about all Brown & Sharpe Grinding Machines. Be sure to write for a copy.

BROWN &

A sure way to eliminate inaccuracy—
Equip your tool-rooms with REX Micrometers

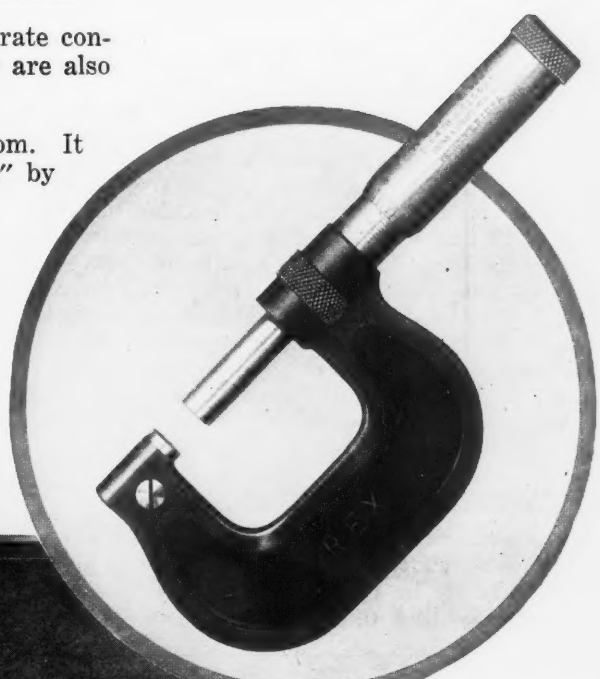
Small errors in grinding often prove costly, but in the shop where tool-rooms are equipped with Brown & Sharpe Rex Micrometers, inaccuracies are practically eliminated.

Rex Micrometers with their strong, light, accurate construction are made in sizes from 0 to 24″. They are also furnished in sets of various sizes.

Set No. 135 is best adapted to the grinding room. It contains six micrometers measuring from 0 to 6″ by thousandths of an inch.

Supply your men with these reliable tools and you can be sure of a high degree of accuracy in your ground work.

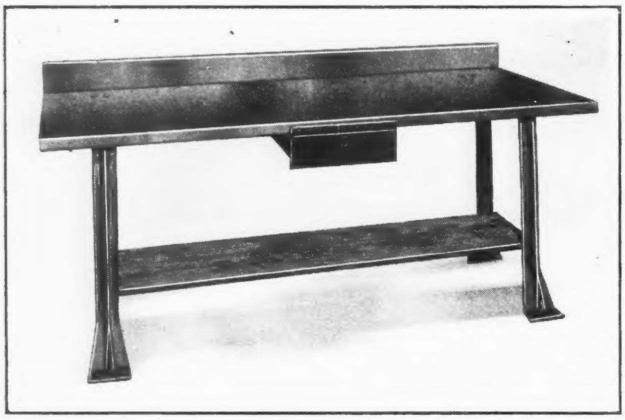
BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I.,
U. S. A.



REX
Micrometer
Set
No. 135

SHARPE

The new Brown & Sharpe Small Tool Catalog No. 29 lists our entire line of micrometers — have you received a copy?



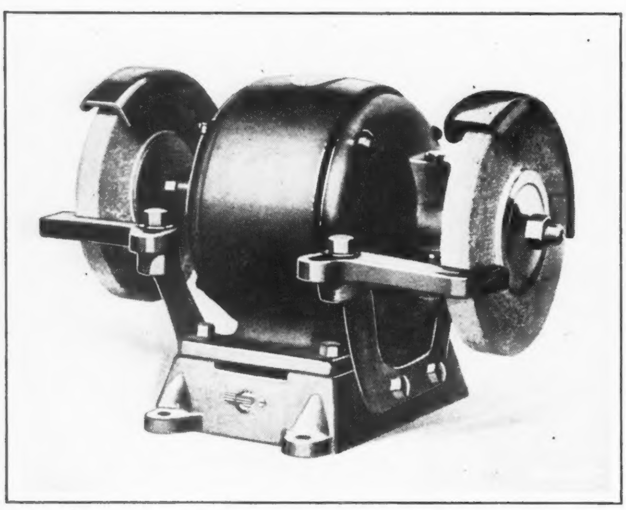
"Armord" Bench Top made of Wood and Sheet Steel

HASKINS "ARMORD" BENCH TOP

A bench top made up of No. 16-gage galvanized steel veneered to a three-ply wooden core is now made by the R. G. Haskins Co., 518½ W. Monroe St., Chicago, Ill., to fit any steel leg on the market. The legs illustrated are not furnished with the top, and the top may be obtained with or without the back. At the front of the bench the steel sheet is bent down to protect the edge. A layer of birch is placed under the steel to reinforce it and resist denting. An advantage claimed for this top is the fact that bulges do not occur due to fastening the metal to wood. The top is 7 feet long and 30 inches wide.

AZOR BENCH GRINDER

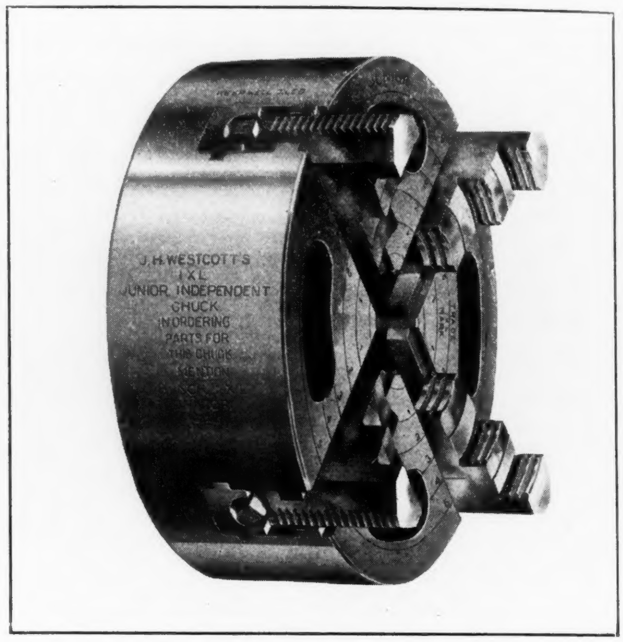
A bench grinder equipped with a 1/3-horsepower motor running at 1800 revolutions per minute is now being introduced on the market by the Azor Motor Mfg. Co., 7424 Bessemer Ave., Cleveland, Ohio. There are two ¾- by 6-inch wheels, each of which is supplied with a work-rest and a guard. The motor is intended for operation on either 110-volt direct or alternating current, a cord and plug being furnished for connecting the equipment to any lamp socket. The over-all length of the bench grinder is 13½ inches, the height 8 inches, and the weight about 40 pounds.



Azor Bench Grinder

WESTCOTT INDEPENDENT LATHE CHUCK

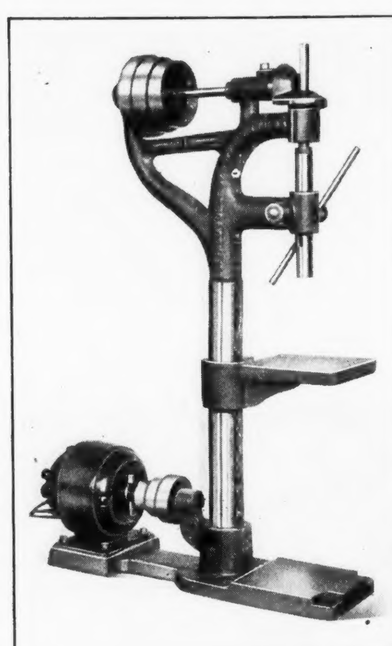
For use on light lathes and in giving instruction in manual training schools, the Westcott Chuck Co., Oneida, N. Y., has brought out a "Junior I.X.L." independent lathe chuck in 5-, 6-, 8-, and 10-inch sizes. This chuck is of the same design as the regular chuck made by this company except that the body, jaws, screws, etc., are lighter. Unusual strength for a chuck of the sizes mentioned is claimed on account of each jaw screw being provided with a hardened steel carrier that serves as a thrust bearing for the screw. Because of this carrier, the thrust does not come on one point, but is distributed so as not to break or spring the chuck body. These screw carriers can be easily replaced as they become worn. The chuck jaws are made of steel, and after being casehardened, are ground and fitted. They are reversible, have deep shoulders, and are turned so as to get a firm "bite" on the work. The screws are made of steel, and are tempered and squared at both ends. All parts are interchangeable.



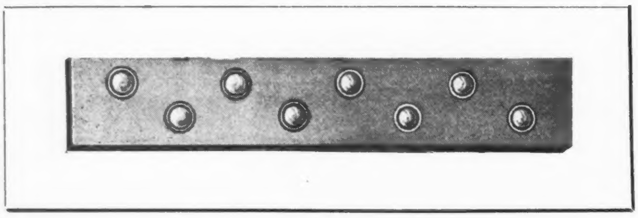
Westcott Independent Chuck for Light Lathes

BUFFALO BENCH DRILLING MACHINE

A new model of the 10-inch motor-driven three-speed bench drilling machine built by the Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y., has just been placed on the market. In this model the drive is direct from the motor without the intermediate pinion and gear previously provided. A three-step cone pulley is keyed, instead, to the motor shaft, and in combination with the overhead cone pulley, furnishes three speeds. The motor rotates at the rate of 1750 revolutions per minute. By changing the type of drive, it has been possible to shorten the length of the base, in addition to making it one solid casting, but the main advantage claimed for the new model is quiet operation. In other details of construction, the machine is similar to the style that has been built by this company for a number of years.



Buffalo Improved Bench Drilling Machine



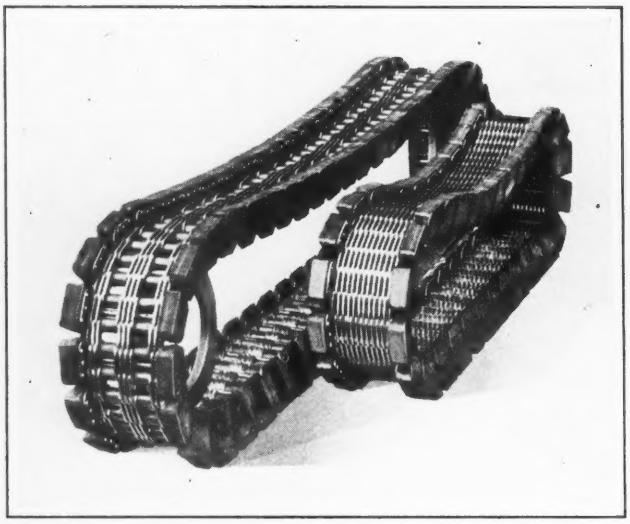
Smith Parallels furnished with Balls to make them slide readily

SMITH BALL-EQUIPPED PARALLELS

Parallels equipped with balls to enable them to slide readily on the table of machines are now manufactured by the J. F. Smith Tool Co., 33 Westview Ave., Dayton, Ohio. It is said that the parallels will be found especially useful in drilling or counterboring heavy fixtures, jigs, dies, or other work in a drilling machine, because they permit the drill or counterbore to pull the work into line with the spindle. The parallels are made in two sizes, 6 and 7 inches long, respectively, and both of these are 1 inch wide. The 6-inch parallel is furnished with 1/4-inch balls, and the 7-inch parallel, with 3/8-inch balls.

REEVES STEEL-LINK V-BELT

One of the new developments of the Reeves Pulley Co., Columbus, Ind., is the steel-link V-belt shown in the accompanying illustration, which is especially designed for use in connection with the variable-speed transmission made by this company. The belt is composed of hardened steel links, flexibly bound together by double frictionless rocking pins. It is a modification of the ordinary type of steel-chain belt, but is strengthened by cross steel pins to withstand the side pressure exerted on the belt by the cone disks used in Reeves transmissions. The tractive power is obtained by leather tips which are cemented and riveted to steel tabs and securely fastened to the sides of the belt at an angle



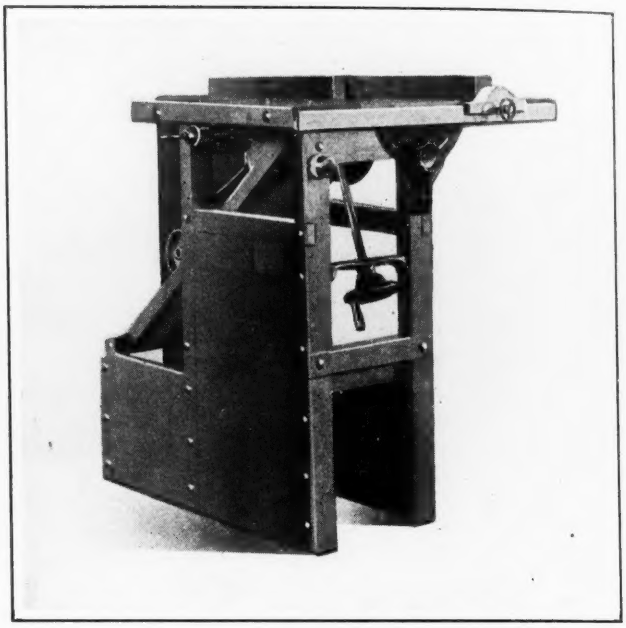
Steel-link V-belt designed for Use with Reeves Variable-speed Transmission

conforming to the V-groove in the transmission disks.

Applying and removing the belt on the transmission is accomplished simply by sliding in or out, the two leather tabs that form the splice joint of the belt. The belt is self-cleaning, and requires only a few drops of machine oil to insure proper lubrication. An oil-cup of ample capacity is centrally located on the transmission frame and an extension distributes the oil to the belt. As the over-all dimensions of the new belt are the same as on the old type belt, it can be applied to transmissions now in service. It is claimed that the construction of the new steel belt makes it practically unbreakable. Owing to its flexibility, the action is smooth at all positions of the disks.

PORTABLE ELECTRIC COMBINATION SAW

A portable electric combination saw is one of the recent products of the Spring Grove Tool & Mfg. Co., Spring Grove, Pa. The saw is equipped with a 1/2-horsepower motor and a 10-inch saw running at 3400 revolutions per minute. It has ample power. for cutting wood up to 2 inches thick. For bevel ripping or miter cutting, the table can be tilted and locked in any position up to 45 degrees. The table measures 24 by 24 inches, but wood extensions can be placed on either side to increase its holding capacity. There is a cut-off and miter guide, which can be used on either side



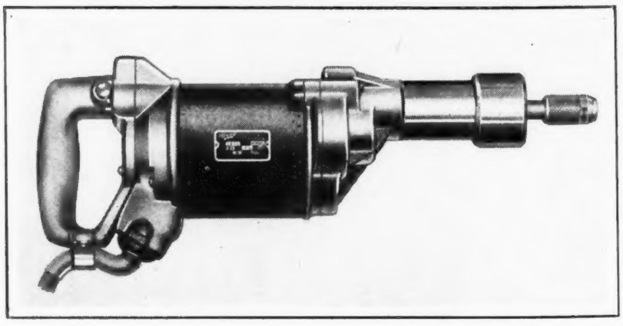
Portable Electrically Driven Saw built by the Spring Grove Tool & Mfg. Co.

of the saw and may be turned to any angle, right- or left-hand, up to 45 degrees, and securely locked in this position. There is also a ripping fence which may be used on either side of the saw for ripping material up to 12 inches wide.

The saw spindle and motor mountings may be raised and lowered as one unit by means of the handwheel shown. This allows the use of a dado head 1 inch wide for cutting grooves to any depth up to 2 inches. There is an extension for the spindle that can be used in boring operations and which may be fitted with a drill chuck as shown. To make the machine portable, the frame is constructed of wood. Either a single-phase motor can be furnished for driving the equipment from a lighting circuit or a polyphase motor for driving from any commercial current.

HISEY FRICTION-HEAD SCREWDRIVER

An electrically driven screwdriver equipped with a disk-type friction clutch that is adjusted automatically according to the pressure applied by the operator, has been added to the line of tools made by the Hisey-Wolf Machine Co.,



Hisey Friction-head Electrically Driven Screwdriver

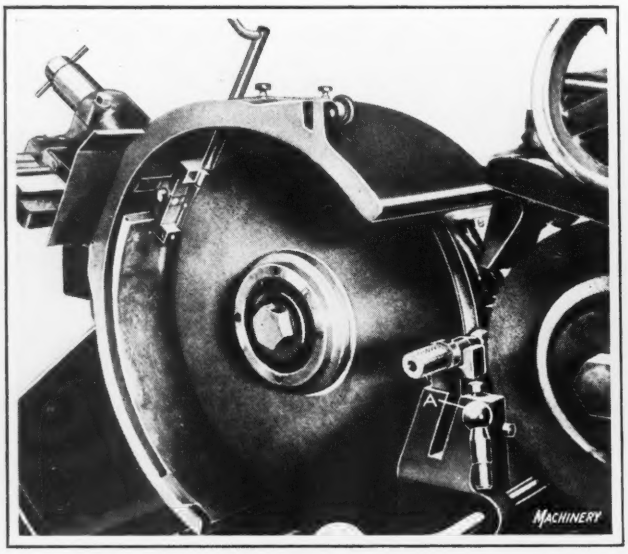


Fig. 1. Finishing the Spherical End of Ball Studs on a Cincinnati Centerless Grinding Machine

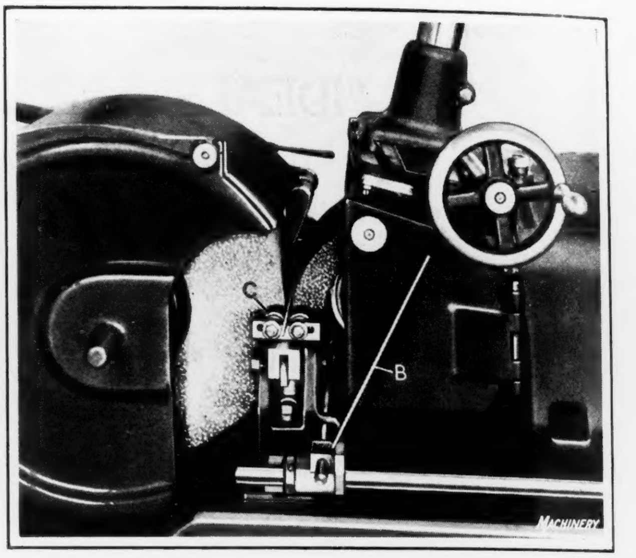


Fig. 2. Grinding the Long Taper, Straight Portion and Short Taper of Spinning Spindle Blades

Cincinnati, Ohio. This clutch design affords the operator full control at all times. Ball bearings are supplied throughout the screwdriver, and the motor is of the universal type for operation on either direct or single-phase alternating current.

Screws up to No. 14 by 2½ inches long can be driven in solid wood, and when suitable lead holes are provided, larger wood screws and lag screws up to 5/16 inch in diameter by 4 inches long, can be driven into place. The machine may also be used for setting nuts up to ⅜ inch in metal and wood, as the slipping feature of the friction clutch eliminates undue strain on the operator while the nut is being driven home. Nut sockets are carried in stock for 1/4-, 5/16-, and 3/8-inch United States standard square and hexagonal nuts. The weight of the screwdriver is about 12 pounds.

* * *

ADVANCED CENTERLESS GRINDING OPERATIONS

Much progress has been made in centerless grinding since this method was first adopted for finishing straight cylindrical parts accurately. New applications are constantly being found for finishing both metal parts, and parts made from hard rubber, rawhide, and other non-metallic materials. Three unusual applications of the centerless grinding machine built by the Cincinnati Milling Machine Co., Cincinnati, Ohio, are described in this article. One of these is the finish-grinding of the spherical end of ball studs such as shown at *A*, Fig. 1, which are used in the steering mechanism of automobiles. The ball proper is approximately 1 inch in diameter and is held within 0.0005 inch for size and roundness. From 0.004 to 0.008 inch of stock is removed, the work being finished within the specified limit in one cut at the rate of eight pieces per minute by the shoulder grinding method. It has been found that approximately 1000 pieces can be finished per dressing of the wheel.

The feed-wheel slide is equipped with a special mechanism to increase its movement with the normal swing of the operating lever, so that the work can be inserted and removed rapidly. Only the grinding wheel is trued to the proper spherical profile by means of a special truing attachment which does not interfere with the regular wheel-dresser on the standard machine. A special support blade is required for the work.

A job that appeared particularly difficult was the grinding of the long taper end on spinning spindle blades, such as shown at *B*, Fig. 2. Instead of swaging these spindles to approximately the required shape and then finish-grinding on centers, as was previously done, ordinary cylindrical stock of the proper analysis is taken, heat-treated, and then ground to size on the machine shown. On practically all of these spindles there is a straight cylindrical section about 2 inches long near one end, and this is ground to the proper diameter by the straight-through method in a centerless machine. The tapers on both ends are then ground, also in centerless machines, by the shoulder grinding method. The long taper that carries the spindle spool requires a wheel 8 inches wide, and the short taper a wheel 4 inches wide. The special roller support *C* carries the overhanging end of the spindle during the shoulder grinding operations.

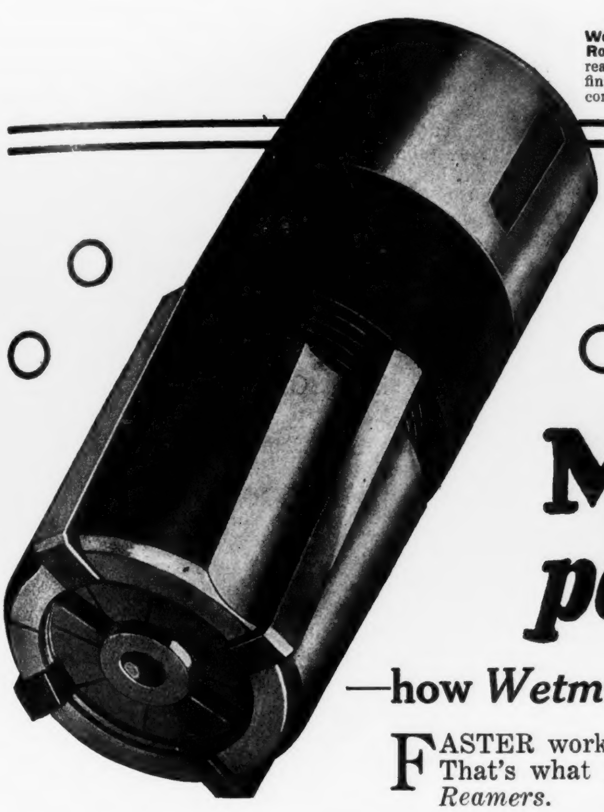
The third application of centerless grinding referred to, consists of forming fountain pen barrels to the required shape in one cut, ready for polishing. The barrels are made from hard rubber tubing, and the average amount of stock removed is 0.025 inch. The operation is performed with the equipment shown in Fig. 3 at the rate of 1000 barrels per hour, which is about 100 per cent more production per man than the manufacturer obtained with his old equipment.

In this case the grinding wheel is trued to the desired shape by means of the special profile truing fixture shown, different shapes being obtained by simply changing cam-plates. The wheel wear is so slight that truing is necessary only once or twice a week. The finish obtained is said to be so satisfactory that polishing costs have also been reduced one-half.

Fig. 3. Form-grinding 1000 Fountain Pen Barrels per Hour

* * *

The yearly index of the thirtieth volume of MACHINERY, September, 1923, to August, 1924, inclusive, is now ready for distribution. Copies will be sent to subscribers upon request.



Wetmore Expanding 4-Blade Standard Roughing Reamer. Especially good for reaming holes preparatory to using finishing reamer, and for reaming cored holes in rough castings.

More Holes *per* Reamer!

—how *Wetmore Reamers* Cut Production Costs

FASTER work—more accurate work—and longer reamer life! That's what you get when you specify *Wetmore Expanding Reamers.*

Wetmore superiorities—many of them exclusive—are not mere claims. They can be proved—have been proved right out on the job, in competition with other reamers. You, too, can make tests—on your own work. See for yourself that *Wetmores* will do finer work, and save you money at the same time.

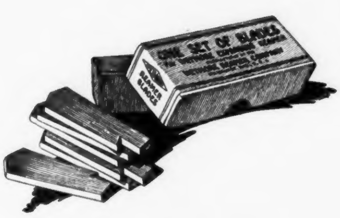
Here are just four *Wetmore* advantages—study them! You know how much they mean to you.

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made. Cone expansion nut keeps blades always parallel with axis.

Solid heat-treated alloy steel body guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering and scoring while backing out. Shearing effect of blades increases life of cutting edge.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.



Blades for All Wetmore Reamers

Scientifically ground for working various metals—steel, cast iron, bronze, etc. Best high-speed steel, ground to thickness, length and on seat. Tested for hardness and toughness. In ordering, give type and size of reamer and whether reamer is to be used on steel, cast iron or bronze.

FREE CATALOG

Write today for Wetmore catalog, showing complete line of standard, heavy-duty, shell, small machine and cylinder reamers. Also arbors and replacement blades. Sent *free—postpaid.*

Wetmore Expanding Six-Blade Standard Finishing Reamer. Assures extreme accuracy and perfect finish. Compare it with others—then judge for yourself. We'll rest our case with you.

Wetmore Reamer Co.
Milwaukee Wisconsin

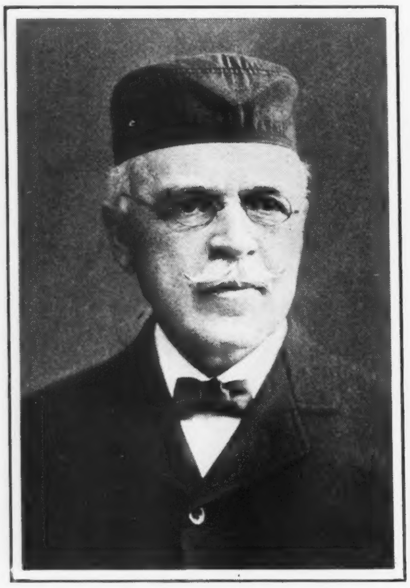
WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

OBITUARIES

HENRY R. TOWNE

Henry R. Towne, chairman of the Board of Directors of the Yale & Towne Mfg. Co., Stamford, Conn., died October 15 at the age of eighty. Mr. Towne was born in Philadelphia, Pa., in 1844. He attended the University of Pennsylvania, and at the outbreak of the War of Secession entered the drafting-room of the Port Richmond Iron Works, where he remained for nearly two years. Later, when that company took the contract to furnish the engines for the Monitor *Monadnock*, Mr. Towne, then twenty years old, was sent to assemble and erect them in the ship at the Charlestown, Mass., Navy Yard. At the age of twenty-one he was placed in general charge of the shops of the Port Richmond Iron Works as acting superintendent.



After the war, he resumed his interrupted lines of study. He accompanied the late Robert Briggs on an engineering tour through Great Britain, Belgium, and France, and took a special course in physics at the Sorbonne University, Paris. Returning to the United States, he spent a year in further study and experimental work, carrying on numerous experiments with leather belting, the results of which were accepted for twenty years to come as the most thorough that had been made. In October, 1868, he entered into a partnership with Linus Yale, Jr., an inventor of locks, whose business, chiefly in bank locks, then employed about thirty-five men. This partnership resulted in the organization at Stamford, Conn., of what is now the Yale & Towne Mfg. Co. The association thus formed lasted but three months, being terminated by the death of Mr. Yale, and ever since then Mr. Towne, first as president, and since 1915 as chairman of the board, has directed the enterprise thus begun.

Mr. Towne was one of the early members of the American Society of Mechanical Engineers. He was president of the society 1888-1889. His contributions to technical literature show a clear appreciation of the relations of theory to practice in useful undertakings. He was one of the first directors of the Federal Reserve Bank of New York.

Patrick F. Bannon, general superintendent of the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., died suddenly at his home in Waterbury on October 19, following an attack of acute indigestion. Mr. Bannon was born in Waterbury, November 22, 1855. Being forced to seek a means of self-support, he left school at the age of twelve and went to work for the firm of Holmes, Booth & Hayden. At the age of nineteen he became an apprenticed machinist at the plant of the Waterbury Farrel Foundry & Machine Co. Thirty years later he was made general superintendent, and has since that time had the direction of the operations of the entire plant.

PERSONALS

Dr. William F. Durand, of Stanford University, California, has been elected president of the American Society of Mechanical Engineers for 1925.

Robert S. Carter, formerly vice-president of the Whitman & Barnes Mfg. Co., Akron, Ohio, has been elected president and general manager of the Latrobe Tool Co., Latrobe, Pa.

William Schwanhausser, chief engineer of the Worthington Pump & Machinery Corporation, 115 Broadway, New York City, was the guest of honor at a dinner given recently by officials of the corporation in honor of his seventieth birthday and to mark the fortieth year of his continuous service with the Worthington organization.

TRADE NOTES

Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill., is now represented in the eastern portion of the province of Ontario, the provinces of Quebec, New Brunswick, Nova Scotia, and Prince Edward Island, Canada, by Williams & Wilson, Ltd., 84 Inspector St., Montreal, Canada.

O'Connell-Bennett Tool Co. has opened an office at 302-303 Elwood Building, 6 State St., Rochester, N. Y., for the sale of the new patented "Obee" feed chuck for automatic screw machines. The company will also handle locally, a large line of small tools and labor-saving devices. The officers are J. R. O'Connell, president and general manager, and John O. Bennett, secretary and treasurer.

Beaudry Co., Inc., Everett, Mass., manufacturer of power hammers and forging dies, has recently moved into its new factory, which is located on the Revere Beach Parkway, within three miles of the business center of Boston. The main building is 140 by 70 feet in size, and is of concrete and steel sash construction. The center bay has a head room of about 30 feet, and is served by an electric traveling crane. The side bays are somewhat lower, and have a balcony for lighter machine work and storage, giving a total floor space of about 16,000 square feet. The arrangement of the equipment is such that the rough material is taken in at one end and travels progressively through the shop to the other end, where the finished machines are turned out.

NEW CATALOGUES AND CIRCULARS

PRESSES. V & O Press Co., Hudson, N. Y. Circular pointing out the principal features of the V & O precision power presses.

HEATERS. Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y. Circular illustrating and describing the "Breezo-Fin" portable motor-driven heater for industrial use.

ELECTRIC BRAKES. Whiting Corporation, Harvey, Ill. Circular illustrating and describing type C electric solenoid brakes, which are especially designed for crane service.

PYROMETERS. Bristol Co., Waterbury, Conn. Bulletin 330, illustrating and describing Bristol's indicating pyrometer, high-resistance model 420, for wall or switchboard use.

DIE-HEADS. Landis Machine Co., Waynesboro, Pa. Circular illustrating the use of the "Land-matic" die-head on actual jobs in automobile plants, railroad shops, and other manufacturing plants.

CENTERLESS GRINDERS. Heim Grinder Co., Danbury, Conn. Circular HG1, illustrating and describing in detail the construction of the Heim centerless grinding machine.

ELECTRIC LIGHT REFLECTOR CLEANING DEVICE. Electric Light & Reflector Cleaner Co., Appleton, Wis. Circular descriptive of a new device for cleaning electric lights and reflectors. The device is so designed that fixtures mounted on the ceilings can be cleaned and polished directly from the floor.

CYLINDER GRINDER. Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis. Circular illustrating the operation of the Gisholt "Du-all" grinder, a portable cylinder grinder and piston-fitting machine designed for use in garages, repair shops, and service stations. The principal features of the machine are pointed out, and examples of work for which it is adapted are shown.

GEAR TESTING MACHINES. Societe Genevoise d'Instruments de Physique, Geneva, Switzerland (American representative, R. Y. Ferner Co., Investment Building, Washington, D. C.). Catalogue 379, describing a new testing machine which provides for testing both straight and bevel gears up to 11 inches in diameter, for errors in eccentricity, pitch, and profile of teeth.

PORTABLE AIR COMPRESSORS. Ingersoll-Rand Co., 11 Broadway, New York City. Pamphlet entitled "One Hundred and One Ways to Save Money with Portable Air Power," describing many new applications of compressed air-operated tools, driven by air from a portable or semi-portable compressor, in building, construction, and repair on railways, in factories, etc.

COMING EVENTS

NOVEMBER 18-19 — Service engineering meeting of the Society of Automotive Engineers at Cleveland, Ohio. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

DECEMBER 1-4—Forty-fifth annual meeting of the American Society of Mechanical Engineers in the Engineering Societies' Building, 29 W. 39th St., New York City.

DECEMBER 1-6—Third National Exposition of Power and Mechanical Engineering in the Grand Central Palace, New York City.

DECEMBER 8-13—Exposition of invention at the Engineering Societies' Building, 29 W. 39th St., New York City. General offices, 47 W. 34th St., New York City.

JANUARY 20-23—Annual meeting of the Society of Automotive Engineers at Detroit, Mich. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.